



# Encouraging Healthful Dietary Behavior in a Hospital Cafeteria: A Field Study Using Theories from Social Psychology and Behavioral Economics

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Encouraging Healthful Dietary Behavior in a Hospital Cafeteria:  
A Field Study using Theories from  
Social Psychology and Behavioral Economics

A dissertation presented

by

Mary Carol Mazza

to

The Department of Business Studies

in partial fulfillment of the requirements  
for the degree of  
Doctor of Philosophy  
in the subject of  
Organizational Behavior

Harvard University  
Cambridge, MA

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**Abstract**

Public policy efforts to curb obesity often adhere to a rational actor model of human behavior, asserting that consumer behavior will change provided proper economic incentives, nutritional information, and health education. However, rigorous academic research related to such questions remains limited in scope and appears inconclusive as to the success of such economic and cognitive interventions. In contrast, research in social psychology and behavioral economics suggests that decision making is partially based on heuristics, or rules of thumb, and susceptible to powerful cognitive biases. External cues can subtly influence decision making in powerful ways.

In this paper, after discussing existing policy efforts and their limitations, we use concepts from behavioral decision theory to design interventions related to different psychological domains in hopes of providing a more complete understanding of consumer dietary decision making. We move beyond traditional cognitive methods, namely the provision of nutritional information and economic incentives, to suggest the value of other cognitive, affective, social, and environmental influences in shaping food choices.

Over a 21-month period, we tested 9 interventions in a point-of-purchase field study at a hospital cafeteria, focusing on the healthfulness of beverage purchases and chip purchases. Information, in the form of novel, reinforcing health messages, had the most consistently beneficial effect on the healthfulness of purchases. Traffic light colored-nutritional labeling,

affect-based cues (smiley faces and frowny faces), and environmental changes including grouping items together based on level of healthfulness (“grouping by healthfulness”) and pairing an unhealthy item with a healthier alternative (“healthy substitute pairing”) also affected choices. Messages related to social norms had no effect on purchases.

Our work adds to existing consumer behavior research and helps to inform health policy of additional cognitive factors and biases that must be taken into account when designing interventions and which can, indeed, be leveraged to influence dietary behavior. This is the first study of which we know to test the relative effects of this number and variety (economic, cognitive, affective, social, and environmental) of theory-based behavioral nudges on food choice in one setting.

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*For Letie, my grandmother,*  
*and*  
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*and*  
*All who love to learn*  
*but who may be unable to engage in formal learning*  
*at institutions like Harvard*  
*due to the times or circumstances in which they live.*

## **The State of Obesity in the United States**

The United States is experiencing a risky expansion. Sixty-eight percent of American adults and 32 percent of American children are overweight or obese (Flegal, Carroll, Ogden, & Curtin, 2010; Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). Today, men and women in the United States weigh, on average, over 20 pounds more than they did four decades ago (Buttet & Dolar, 2010).<sup>1</sup> This weight gain has brought with it many health consequences, including increased risk of cardiovascular disease, type 2 diabetes, stroke, and some cancers, although few Americans recognize many of the associated risks (Associated Press, 2013; "Overweight and obesity," 2011). Obesity, which already claims 160,000 "excess" deaths in the United States each year, may soon overtake smoking as the leading cause of preventable death (Freedman, 2011; Mokdad, Marks, Stroup, & Gerberding, 2004).

The financial costs of obesity are staggering: The additional medical expenses for obesity alone are \$147 billion each year, roughly \$2,000 a year for each obese person (Finkelstein, Trogon, Cohen, & Dietz, 2009).<sup>2</sup> On top of that, the annual productivity losses for an obese employee add up to \$575, costing business \$73.1 billion a year (Finkelstein, DiBonaventura, Burgess, & Hale, 2010; Gates, Succop, Brehm, Gillespie, & Sommers, 2008). All combined, the annual tangible costs of being obese are \$4,879 for an obese woman and \$2,646 for an obese

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<sup>1</sup> The average weight of adult men and women, respectively, increased by twenty-two and twenty-three pounds between 1971 and 2006 (Buttet & Dolar, 2010). Estimates based on the National Health and Nutrition Examination Surveys (NHANES) and Coronary Artery Risk Development in Young Adults (CARDIA) study calculate an average weight increase of 0.9 to 2.5 pounds each year for American adults (Lewis et al., 2000; Rozin et al., 2011).

<sup>2</sup> Current projections estimate health-related obesity expenses will swell to over \$340 billion by 2018; the government would be responsible for about 60% of the bill (Bittman, 2011).

man (Dor, Ferguson, Langwith, & Tan, 2010).<sup>3</sup> However, when factoring in premature death to the aforementioned costs, the price tag for an obese person climbs to roughly \$7,400 annually (\$8,365 for obese women and \$6,518 for obese men) (Dor et al., 2010).<sup>4</sup>

### **Primary Efforts to Combat Obesity in the United States: Economics and Education**

While a host of factors contribute to obesity, overeating appears the largest culprit (Cutler, Glaeser, & Shapiro, 2003).<sup>5</sup> The causes of overeating are presumed to be, in essence, educational and economic in nature. In terms of education, people may lack sufficient knowledge about dietary matters and health and nutrition.<sup>6</sup> If they had a better understanding of these areas, then they might eat less. On the other hand, unhealthy “processed” foods laden with salt, sugar, and other ingredients thought to induce overconsumption tend to be the cheapest foods while healthier foods cost more (Hauter, 2012; Moss, 2013; Warner, 2013). Thus,

---

<sup>3</sup> The financial cost of additional pounds is not a linear function, for either men or women. Obesity is far more costly than being overweight. (It is, however, unclear whether it is exponentially more costly or if there is a kink in the cost curve). The total annual cost of being overweight is \$524 and \$432 for women and men, respectively. As noted, the total annual cost for being obese, not including loss of life, is \$4,879 and \$2,646 for women and men, respectively (Dor et al., 2010). Thus, the cost of being an obese woman is over nine times that of being an overweight woman. For men, the same comparison is greater by a factor of six. Additional pounds, in a sense, do not carry the same financial weight and suggests that obesity is financially a far greater problem than being overweight. This is worth noting as different mechanisms may be required to fight obesity than are needed to move an overweight person into a healthier weight range.

<sup>4</sup> The greater financial burden for obese women is due mostly to lost income, as obese women appear to be paid lower wages than women who are not obese while obese men do not experience the same salary discrimination (Dor et al., 2010).

<sup>5</sup> Beyond overeating and excess energy intake in general, evidence suggests a positive relationship between intake of sugar-sweetened beverages and obesity in children. In light of this, the American Academy of Pediatrics considers the reduction in consumption of these drinks to be a weight management strategy for young children (Davis et al., 2007). For adults, the American Heart Association’s Diet and Lifestyle Recommendations in 2006 instructed people to minimize the intake of sugar-added beverages and foods. The specific recommendation stated that most people should keep their intake of added sugars in food or drink to no more than 100 calories per day (25 g or 6 tsp) for women and 150 calories per day (38 g or 10 tsp) for men (Fitch & Keim, 2012). We will address sugar-sweetened beverages specifically later in this paper.

<sup>6</sup> Much of the “education” people receive occurs from or may be obfuscated by savvy marketing that shapes perceptions and desires (Cairns, Angus, & Hastings, 2009; Gortmaker et al., 2011).

economics plays a role in making it “expensive” to eat more healthfully. Another economic argument asserts that the financial consequences of overeating are not born directly by the individuals responsible for the behavior but instead inappropriately fall on taxpayers (Just & Payne, 2009). Hence, the penalty for excess food consumption is borne by everyone rather than the individual alone paying the full price. In this respect, the act of overeating and the consequences it has on the weight of an individual have evolved from personal, private matters to societal concerns, evoking political debate and national attention. Consequently, this has motivated public policy efforts which have and continue to focus on public information campaigns and economic incentives—including “fat taxes”—to curb the behavior (Just & Payne, 2009; Wisdom, Downs, & Loewenstein, 2010).

### **Economic Interventions**

Perhaps the most widely debated of such taxes in the United States concerns one on sugary soft drinks.<sup>7</sup> Evidence of the detrimental impact of sugary soft drinks on America’s expanding waistline provides the justification, but forceful and thus far successful opposition by the powerful soft drink industry shows that vested economic interests exist within the private as well as public sector (Arkowitz & Lilienfeld, 2009; "Should there be a 'fat tax'?", 2011).

An alternative strategy to targeting one consumer industry would be to focus on lifestyle choices, as lawmakers in Arizona have recently attempted to exact penalties on unhealthy lifestyles by proposing a \$50 annual fee on some Medicaid recipients who are not actively

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<sup>7</sup> The terms “soft drink” and “soda” will be used interchangeably in this paper, although “soda” was first referenced in 1558 (with “soda-water” appearing in 1798 and “soda pop” in 1863) while the term “soft drink” was not introduced until 1880. The word “pop,” first used in 1812, does not appear in this paper, as the author has, to date, never resided in the northwestern or mid-western United States, Canada, or England where the term is particularly popular (Von Schneidemesser, 1996).

attempting to improve their health ("Should there be a 'fat tax'?", 2011). In contrast to this punitive approach, a new federal grant program offers states \$100 million in gift certificates or coupons to encourage Medicaid recipients to engage in healthy behavior, including weight management (Miles, 2011). A third option, using both carrots and sticks, appears in the 2010 Affordable Health Care Act which permits employers to reward or penalize employees by up to 30% of health insurance premiums based on whether they meet specific health targets (Miller, 2010). Whether altering the price of food directly or financially incentivizing good behavior, linking caloric consequences to dollars is becoming a popular proposal in the United States.

**Price elasticities.** However, research related to economic factors, most of which is limited to studies of price changes, suggest that the impact on calorie consumption of such interventions and the effect on weight may be minimal. First, consumer demand for certain consumables may be unresponsive to prices such that the decrease in product demand is less than the increase in price on a percentage basis (Kuchler, Tegene, & Harris, 2004). Evidence suggests that food consumption is remarkably inelastic, meaning the demand for food is not particularly sensitive to or highly influenced by price (Allais, Bertail, & Nichele, 2008; Beatty & LaFrance, 2005; Huang & Lin, 2000). In a review of 160 studies on price elasticity, the price elasticities for foods and nonalcoholic beverages ranged from 0.27 to 0.81, meaning that for every 10% increase in price, demand for foods and nonalcoholic beverages drops by only 3-8%, roughly. Soft drinks, juice, meats, and food consumed away from home appear to be the most sensitive (0.7-0.8) to price changes, with a 10% increase in price for these products resulting in a 7-8% decrease in sales (Andreyeva, Long, & Brownell, 2010). Starchy foods, which represent a sizeable source of food calories but a small percentage of food expenses, appear to have extremely low price elasticities (Bonnet, Dubois, & Orozco, 2009). This is critical as it suggests

that small price changes have little effect on consumer demand, and that large price changes may be needed to produce the desired effect. But large price changes are often politically untenable, as taxes on sugary soft drinks have faced steep opposition from beverage lobbyists and the financial heavyweight, the soft drink industry, behind them (Hamburger & Geiger, 2010).

Even if price increases were successfully implemented, and the demand for high-calorie foods decreased, empirical evidence indicates that the impact of the tax disappears when paired with calorie information—which is the most widespread intervention, as discussed later in this paper (Giesen, Payne, Havermans, & Jansen, 2011). Consequently, imposing higher prices on consumers may not be the best way to encourage healthier eating habits.

**Cross-price elasticity of demand.** While we have offered evidence of the challenges inherent in using price changes and taxes to affect consumer behavior, of critical importance are potential secondary effects and adverse consequences of such efforts. Price elasticities usually evaluate responsiveness to price in terms of “own price elasticity,” that is, the percentage change in quantity demanded that results from a given percentage change in price (Epstein et al., 2012). However, this does not take into account shifts in other purchases, which could counter some of the benefits of the apparent price changes of the targeted products (Epstein et al., 2012). For instance, increasing the price of junk food might also decrease the amount of money available for healthful food purchases, assuming the same level of food expenditures and holding constant the amount of junk food purchased pre and post-price change. By the same logic, decreasing the price of healthful food could increase the cash available for junk food.

Aside from an argument based on financial resource availability, taxing unhealthful foods to reduce total calories purchased could have the opposite effect due to cross-price elasticities (Mytton, Gray, Rayner, & Rutter, 2007; Schroeter, Lusk, & Tyner, 2008). The cross-price

elasticity of demand is a measure of the change in the demand for one good (Y) due to a change in the price of another good (X). If the two items are substitutes such that one might buy Y or X for a similar purpose, then an increase in the price of X will lead to an increase in the demand for Y. For instance, if potato chips and carrots are snack substitutes, then a tax on potato chips, if sufficiently high, would theoretically result in an increase in carrot purchases. Alternatively, if the two items are seen as compliments, such that one naturally pairs Y with X or uses the two items together, then an increase in the price of X will lead to a decrease in the demand for Y due to the expected decrease in demand for X, making the pairing of the two items more costly than pre-tax. So if high-fat snack dip is seen as a compliment to carrots, then an increase in the price of the snack dip may lead to a decrease in both snack dip and carrot purchases. This suggests, further, that the consumer could lose out on the healthful carrot nutrients due to the calorie-cutting intentions of the snack dip price increase (Allais et al., 2008). While this may still be a net gain for the person's health, it is not always clear and such considerations may be overlooked. In this case, it might not be a net gain for the person's health if the person tended to eat a larger amount of carrots in relation to the snack dip, such that the beneficial nutrients of the large carrot consumption did outweigh the negative impact of the snack dip.

However, the categorization of food items as substitutes or compliments is not always obvious and depends on a host of factors including consumer preferences and, at times, irrational decision making. For example, research of vending machines revealed that dropping the price of low-fat snacks by 25% and 50% increased snack purchases overall, but the proportion of low-fat snacks purchased did not increase (French et al., 2001). In other words, more low-fat snacks and more high-fat snacks were purchased when low-fat snacks were cheaper, but the increase in low-fat snack purchases must have been similar to the increase in high-fat snack purchases since the

proportion of low-fat to high-fat snacks did not change. Such an outcome suggests the two may be compliments, as a price drop in the low-fat items makes the combined purchase of low-fat and high-fat cheaper than otherwise and increases demand for both. However, the reason why low-fat and high-fat snacks in a vending machine would be seen as compliments is not straightforward. Instead, the two may be substitutes, as a combined purchase of each item is cheaper than previously but not as cheap as the purchase of low-fat snacks alone. Yet, the price difference (or cost savings) between a purchase of low-fat only snacks and a combined high and low-fat snacks purchase may not seem sufficient enough to warrant the low-fat only snacks purchase (particularly when considering that consumers are biased towards variety seeking—especially when purchasing for future consumption).

Moreover, given that most food and snack items are composed of multiple nutrients, with a label such as “low-fat” acting as only a partial and therefore inherently limited description, the impact of price on the purchase of actual nutrients appears much more complex. Using per capita food consumption data and translating it into its nutrient values, Huang and Lin (2000) attempted to model the effects of price manipulations on different nutrients. Given that food choices are interdependent and by definition affect nutrient consumption, these and other researchers have found that a price decrease for fruits or vegetables would encourage their consumption but may also increase the demand for total fat (Chouinard, Davis, LaFrance, & Perloff, 2007; Huang, 1999; Huang & Lin, 2000; Ogden et al., 2010). In a thorough review of the elasticity literature, Andreyeva et al. (2010) did not find any studies that estimated cross-price elasticities (or price elasticities) for many of the foods in the Dietary Guidelines for Americans, and despite an increased focus on nutrient density, they did not find any elasticity estimates for individual nutrients, like saturated fat. Thus, the research suggests that price



changes do alter people's purchases of targeted food items, but due to substitution effects, the overall nutritional quality and worth of the basket of purchased goods is mixed as people may substitute items of equally poor nutritional content (Epstein et al., 2012)

**Cautionary tale of Denmark.** In terms of the international landscape and what other countries and regions are attempting with regards to taxing foods in a public health (and revenue generating) effort, Europe has taken the most aggressive economic stance against foods that potentially promote excessive weight gain, which are termed "obesogenic" foods. Hungary, for instance, a country where residents already spend twice as much of their household income on food as compared to those in the United States, implemented fairly comprehensive taxes in September 2011 on foods with high sugar, fat, salt, and caffeine content while also increasing the tariffs on soda and alcohol (Cain, 2011; Villanueva, 2011).

However, other countries have been forced to backtrack due to unforeseen consequences. Denmark, the first country to ban trans fats in 2004, placed a tax on foods high in saturated fat (over 2.3% saturated fat) in the fall of 2011 (Abend, 2011). Given the saturated fat focus of the tax, it was applied to foods like potato chips and hot dogs and butter (with a pound receiving a 37-cent tax)—but also cheeses and meats, with cuts of lean meats being taxed like fattier pieces because of the way the tax was implemented (per carcass rather than per cut). Potentially as a result, cross-border shopping rose 10% above the previous year, with 48% of the country heading to places like Germany or Sweden to stock up. Retailers in Denmark complained of both the burden of implementing the new tax system and the lost business to other countries ("Denmark's food taxes: A fat chance," 2012). Higher end supermarkets also appear to have partially absorbed the tax increase, rather than passing it on entirely to consumers, while some discount stores may have used the tax as an opportunity to increase their profit margins on items

like butter and margarine—neither of which were intended effects of the tax (Smed & Robertson, 2012). Consequently, just over a year later, the government abolished the tax, owing to a variety of negative side effects ("Denmark's food taxes: A fat chance," 2012).

As another indirect consequence, the Danish government, seeing their attempt at fiscally engineering a healthier society fail, decided to also abandon a planned tax on foods high in sugar, which seems particularly unfortunate given the recent research suggesting the need to shift the public health dialogue from fears of saturated fats to the less-discussed but potentially more serious health consequences of sugar ("Denmark to abolish tax on high-fat foods," 2012; Hu, 2010; Jakobsen et al., 2010). The real Danish lesson may be—aside from the obvious power of business interests and industry opposition to food taxes and the challenge of targeting a specific nutrient rather than specific food items—that one failed food policy may lead to the erosion of additional future ones, essentially pulling the society back in its legislative efforts to promote health rather than propelling it to a healthier future.<sup>8</sup>

**How economics impacts weight.** In considering taxes, it is important not to lose sight of the ultimate intention of the taxes—to improve health and in the most immediate sense, help people reduce or maintain a healthy weight. In examining how price changes and subsequent food demand changes translate over to weight changes, Kuchler, Tegene, and Harris (2004) report that raising the price of potato chips by 20% would trim bodyweight by a mere ¼ pound

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<sup>8</sup> Preliminary research by economists at the University of Copenhagen suggests that three months after the Danish tax was introduced, the market demand for butter, margarine, and oils dropped by 10-20%. However, this may be attributed to pre-tax hoarding of these items, rather than an actual decrease in demand and consumption (Jensen & Smed, Working Paper). In the end, the duration of the tax was too brief to expect any long-term public health improvements.

per year.<sup>9</sup> Using the National Health and Nutrition Examination Survey (NHANES) dietary data, Fletcher, Frisvold, & Teft (2010) estimated that a 1% higher soft drink tax led to a decrease of 8 calories per day from soft drinks, but this decrease was entirely compensated by a substitution to whole milk and juices, resulting in no net caloric intake change. Other researchers have estimated that a 10% tax on high-calorie foods would yield only small changes in the short run but possibly more sizeable ones in the long run. The long run, however, could be more than seven years (Allais et al., 2008). Moreover, empirical studies suggest that changes in aggregate food prices over time have little effect on the population body-mass index or obesity prevalence (Chou, Grossman, & Saffer, 2004; Chouinard et al., 2007; Gelbach, Klick, & Stratmann, 2009).<sup>10</sup>

But another financial factor, household income, may play a significant role. In a recent study of the impact of changes in food prices and household income on eating decisions and weight, Buttet and Dolar (2010) use dynamic modeling to show that, between 1971 and 2006,

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<sup>9</sup> Put another way, a 10% increase in the price of potato chips—an increase of about 2 cents an ounce—would reduce household purchases of potato chips by 4.5 percent annually (7 ounces out of 156 ounces) (Kuchler et al., 2004).

<sup>10</sup> More recent research calls into question much of the past research estimating the impact of interventions on weight changes at both the individual and the population level due to the overly simplistic but inaccurate rule that has been propagated for estimating human weight change, namely that reducing energy by 2 MJ per day will yield weight loss of about 0.5 kg per week, or what in the United States is understood as a 500 calorie deficit a day (3,500 in a week) being equivalent to a pound of weight loss (Hall et al., 2011). These numbers are based on the energy content of weight (in kilograms or pounds), but do not take into account the dynamic changes to the metabolic rate that occur with weight changes and changes in body composition (fat mass and lean mass). More recently, a report using a mathematic modeling approach to metabolism attempted to explain and predict more accurately the bodyweight time course, that is the adjustments in energy expenditure that occur with weight loss, whereby changes in body composition (fat-lean mass) affect caloric needs and metabolic rates within the body. When considering the impact of an intervention or behavior change affecting energy intake, a more accurate approximation of the dynamic metabolic changes suggests that “every change of energy [caloric] intake of 100 kJ [10 kcal] per day will lead to an eventual weight change of about 1 kg [1 lb.], with half of the weight change being achieved in about 1 year and 95% of the weight change in about 3 years” (Hall et al., 2011, p. 826). In this paper, we cite the extant research available, which, largely, casts doubt on the success of most economic interventions to affect weight; however, we note that past research may have meaningful flaws in overlooking the dynamic physiological adaptations that occur during weight loss or weight gain.

changes in household income accounted for more than 70% of America's weight gain.<sup>11</sup> In contrast, when taking into account other variables like increases in household income, food prices were responsible for almost none of the country's weight changes.

To better understand why changes in food prices between 1971 and 2006 did not contribute to changes in weight during that span of time, we must understand the relationship between changes in food consumption inside and outside the home, the change in the price of food items, the change in price per calorie, and the change in household income during this time. First, with regards to foods consumed at home, the actual composition of those foods has changed (Cutler et al., 2003). Technological innovations in food processing and manufacturing in recent decades have enabled the mass production of ready-to-eat meals by enabling the control of temperature and atmosphere, the preservation of flavor and moisture, and the prevention of spoilage from microorganisms (Kelsey, 1989). As the food industry exploited economies of scale in producing foods in plants and shipping them across the country, the average cost and thus retail price of these industrially "pre-prepared" foods fell. Households began eating more of these manufactured foods and less home-made foods. While it is tempting to believe that the price and the overall financial affordability of these mass-produced food engendered their uptake, Cutler, Glaeser, and Shapiro (2003) suggest that the primary cost, in decades past, of food may have been the time-cost of food, that is, the time needed to clean and prepare the food—and the necessary delay before consumption—rather than actual ingredient cost. For instance, in 1965, an average family in the United States spent \$15 a day on the cost of food and

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<sup>11</sup> The authors use economic theory to model food choices, positing that actors are fully rational and forward-looking (Buttet & Dolar, 2010). While we disagree with the fundamental premise of a rational actor model, we still present this as research that extends our understanding of the relationship between food prices, weight, and weight loss by adding in important factors like household income and food composition that are often missing from other discussions.

about 130 minutes on preparation and clean up (Robinson & Godbey, 1997). Given the average wage for a woman in that time period, the time cost amounted to about \$20, more than doubling the real price of the food expenditures. The rise of prepared foods has cut the time required for preparing foods in half over the past few decades. Thus, the changing composition of in-home food consumption may be less related to the actual cost of the food and more related to the cost of time, especially a woman's time cost, as more women entered the workforce outside the home and faced more demands on their time—and more explicit temporal-monetary tradeoffs (Cutler et al., 2003).

Given that reduced time costs affect not only the price of food but also the delay before consumption, even people who are not particularly price sensitive will be impacted by the changes in time delay. As we will discuss later in the paper, people tend to value the present over the future—appearing present-biased and discounting hyperbolically—preferring to engage in current pleasure rather than delay for future benefit. This becomes problematic in a food environment where the time delay for consumption has been decreased from hours to seconds. When food preparation took hours, the preparation time served as an automatic self-control mechanism, preventing people from consuming calories and forcing them to wait. When such a delay ceases to exist, the exertion of self-control lies completely with the consumer, who now often has the flexibility to eat whatever he likes, whenever he likes, wherever he likes. Hence, one of the detriments of food technology appears to be the ubiquitous availability of calories with minimal delay, which when coupled with our tendency for instant rather than delayed gratification, can lead to weight problems in society (Cutler et al., 2003).

Next, if we distinguish between calories consumed at home and those away from home, the fraction of calories away from home increased by 11 (29.9-40.5) and 17 (18.5-35.9)

percentage points for men and women, respectively, between 1971 and 2006. Over 50% of this increase in caloric consumption outside the home can be attributed to price changes. The relative price per calorie of food consumed away from home declined by 17% as compared to food consumed at home (Buttet & Dolar, 2010). In other words, as compared with 1971 figures, in 2006, it was relatively less costly to consume calories outside the home as compared with inside the home and, consequently, might provide one reason why Americans were consuming a greater portion of their daily calories outside the home. To this we must add growing amounts of research which reveal a positive relationship between food consumption outside the home and weight gain (Poti & Popkin, 2011). Taken together—the lower price per calorie of out-of-home food consumption, the increased intake of such food, and the sizeable weight gain—it is tempting to believe that falling prices of food outside the home are a major culprit.

But the story is much more complicated. The price of food consumed away from home, as opposed to price per calorie of food, has actually increased by 40% (Buttet & Dolar, 2010). This means that the price of a \$1 food item consumed outside the home went from \$1 to \$1.40, a 40% increase, adjusting for inflation. But given, as we noted before, that the price per calorie of food dropped by 17%, a \$1 food item that contained 100 calories and now costs \$1.40, would also now contain 168 calories. The food item has become relatively more expensive, but the caloric value of the food item has become relatively cheaper. This paradox may potentially be explained by the increased size of food items and reformulations of ingredients to make pre-prepared and packaged foods compared to those same or similar food items in the past.

If the food item itself has become relatively more expensive while also being in greater demand as evidenced by the increase in the amount of food consumed outside of the home, then other financial factors, like household income, require our attention. During this time period,

real household income increased by 24% (Buttet & Dolar, 2010). So \$1 in household income in 1971 had increased to \$1.24 by 2006 (adjusting for inflation). Given this, it should be obvious now that the cost of food items outside the home outpaced the increase in real household income such that an item that cost \$1 in 1971 now costs \$1.40 but income of \$1 in 1971 had increased to only \$1.24 in 2006. Thus, in 2006, only a portion of the food item, 88.57%, which now costs \$1.40 could be purchased with the \$1.24 in real income. Had the caloric value of the food item remained the same, consumers would be purchasing fewer calories for their dollars in 2006 than in 1971, since in 2006, the person can only purchase 88.57% of the item. However, 88.57% of this item, which now has 168 calories, contains 148.8 calories, (compared with 100% of that same \$1 item in 1971 which had 100 calories). Thus, the person is purchasing nearly 50% more calories in the same item despite the fact that the cost of food has risen faster than household income.

Consequently, the change in food prices—when we control for the change in household income—does not explain America’s weight gain, when also considering the change in food composition inside the home with pre-prepared foods and the increased food consumption outside the home. Indeed, the decrease in the relative price per calorie of food may have more to do with the obesity epidemic than any changes in food prices per se. Thus, while food prices may impact what people eat, its impact on reducing body-mass index and obesity may be limited. From this we conclude that focusing on food prices as a means of reversing the weight gain trend may be misguided—or at least less effective than targeting other factors that empirically have been shown to affect weight.

## **Information Effects on Food Consumption**

A general premise behind increased nutrition education and calorie posting is that people do not have this information or that the information that they do have is inaccurate, and that if they were to have such information, they could make better, more informed, and healthier decisions (Bollinger, Leslie, & Sorenson, 2010). To this end, Congress passed the Nutrition Labeling and Education Act of 1990 (NLEA) (21 U.S.C. 301), which required food manufacturers to provide complete and truthful nutrition information about their products by May 1994. The expressed intention of the law was to provide consumers additional information at the point-of-purchase with which to inform their purchases as well as to reduce the negative impact of false or exaggerated claims by food producers (Golodner, 1993). However the NLEA focused on mostly packaged food products like those in the grocery store and excluded restaurants from such requirements.

In 2008, New York City became the first city in the nation to require restaurants to display caloric information for menu items, requiring restaurant chains with 15 or more outlets to display caloric information (amounting to less than 10% of the city's 23,000 food outlets) (Barron, 2008). Despite backlash by the restaurant industry and legal opposition to the regulations by the New York State Restaurant Association, the law went into effect. Other cities, such as Seattle and Philadelphia, followed suit (Barron, 2008; Romeo, 2007).

More recently, H.R. 3590 Patient Protection and Affordable Care Act requires restaurant chains across the United States with 20 or more outlets to list caloric information on menus, menu boards, drive-through boards and even vending machines ("Patient Protection and Affordable Care Act," 2010). Additional information like saturated fats, carbohydrates, and sodium levels must be provided upon customer request. The law will not be enforced until



January 1, 2014, leaving restaurants plenty of time to change their recipes—or continue the legal debate (Spencer, 2010). The Academy of Nutrition and Dietetics, formerly the American Dietetic Association, has expressed support, stating that “providing good, accurate, and tested information to a consumer educated in nutrition basics can have a powerful effect on food selection at the point of sale” (American Dietetic Association, 2009).<sup>12</sup>

Yet, displaying caloric and nutritional information has not been the panacea that policymakers had hoped. A recent study in King County, Washington, captured much attention when the authors concluded that “mandatory menu labeling did not promote healthier food-purchasing behavior” (Finkelstein, Strombotne, Chan, & Krieger, 2011, p.122). The authors compared the average calories per drive-through transaction for 7 restaurants in a Mexican fast-food chain and 7 control locations for 7 months before and 6 months after King County implemented a calorie-posting law. They found no difference in the calories ordered.<sup>13</sup>

And in fact, research on the effect of point-of-purchase calorie posting and nutrition information on cafeteria and restaurant food choice dates back several decades and taken as a whole, reveals weak and inconsistent evidence of the benefits of this type of information (Harnack & French, 2008). Cinciripini (1984), for example, evaluated the influence of calorie information at a college cafeteria primarily frequented by undergraduate students. Caloric

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<sup>12</sup> The American Dietetic Association changed its name to the Academy of Nutrition and Dietetics in January 2012. As their website notes, “The new name complements the focus of the organization to improve the nutritional well-being of the public, while communicating the academic expertise of Academy members and supporting the organization's history as a food and science-based profession.... The field of nutrition has changed over this century, and we're evolving to meet these needs” (Academy of Nutrition and Dietetics, 2013). At the time they voiced support for calorie information in chain restaurants, the organization was still referred to as the American Dietetic Association.

<sup>13</sup> While we note a limitation of this study might be the short time period it covers, including only 6 months of data after the menu labeling was put in place (and 7 months prior between the enactment of the law and the start of the menu labeling), it is not clear what length of time is sufficient to allow for adequate measurement of results from nutrition labeling interventions. Interventions of this sort may have the biggest effect early on, with changes in sales leveling off over time.

content of foods was placed at the entrance of the cafeteria and in leaflets which were distributed. Only the sales of foods high in carbohydrates were significantly affected by all sex and bodyweight groups.

Milich and colleagues (1976) also looked at the effect of calorie labeling, but rather than offering the information at a “distance” (i.e., at the entrance of the cafeteria or in a handout), he placed caloric values adjacent to each food item in a hospital cafeteria, using 5cm x 5cm cards and red ink. Tracking only the purchases of female patrons, the researchers noted that the average calorie composition of meals was significantly lower during the calorie-labeling period (459 kcal/meal) than during baseline (507 kcal/meal) or a price increase (525 kcal/meal) period ( $p < 0.02$ ). While this early finding may seem hopeful, a decade later, a similar study in a Fortune 500 company listed the calorie content on index cards and, looking at both females and males, found no difference in the mean number of calories purchased before, during, or after the intervention (Mayer, Brown, Heins, & Bishop, 1987).

A variety of explanations have been offered to explain these somewhat disappointing results. First, consumers have to use the information and not everyone is interested in doing so, as half of the respondents to one survey admitted (Krukowski, Harvey-Berino, Kolodinsky, Narsana, & DeSisto, 2006). And even when consumers use the information, they may not change their purchasing behavior. At two worksite cafeterias, less than half of the diners were interested in using the computerized nutrition info and, of those who did, roughly one out of six chose a lower calorie option than they had originally intended based on the information. This implies that less than 10% of the customers made a healthier choice because of the existence of the nutritional information (Balfour, Moody, Wise, & Brown, 1996).

Early research around New York's mandatory calorie labeling law further adds to our understanding of what may be happening when customers making food decisions with nutrition information present. Researchers surveyed and recorded purchases of customers at several prominent fast food establishments in New York City including McDonalds, Burger King, Kentucky Fried Chicken, and Wendy's (Elbel, Kersh, Brescoll, & Dixon, 2009). Only 50% of customers reported noticing the nutritional labeling and only half of those stated that the new information influenced their food choice. However, comparing food purchases before and after those restaurants provided nutrition labeling and comparing to the same chains in comparable areas just outside of NYC, calories per purchase did not appear to change. This seems troubling: Only a subset of consumers, as in earlier studies, noticed the nutritional information. The percentage of customers acknowledging the nutritional information continues to hover around 50%. Additionally, similar to the cafeteria studies, their purchasing behavior did not appear to change. However, the surveys indicate that people do think they are being influenced. Roughly 1 in 4 reported noticing the nutrition information and that the information affected their purchase. This is either true or a misperception, but either way, they did not make healthier food choices. Such perceptions could prove problematic if consumers believe the information led them to make a healthier purchase, and they make subsequent food choices based on such presumptions. It is possible that such misperceptions or false health halo could result in their inadvertently eating less healthfully (or paying less attention to their dietary habits) later in the day, potentially compensating for the presumed calorie savings or even overcompensating, leading to a greater daily caloric intake than otherwise. This is clearly not the intent of calorie labeling and would be an unfortunate outcome.

Beyond perceptions, providing nutritional information may have an impact on actual behavior but it may not be the intended impact. A study evaluated New York's calorie labeling efforts by comparing purchases at Starbucks coffee shops in that city with those in other cities (Bollinger et al., 2010). The research found that calories per transaction fell by 6% in Starbucks locations with calorie postings, but that the effect was almost entirely due to changes in food purchases, with people opting not to purchase or purchasing smaller food items. Beverage consumption—arguably the target category in a coffee shop—remained the same as prior to the labeling.

Moreover, dieters—a sub-set of the population for whom the information is especially intended to help—may actually increase their caloric intake in response to such knowledge. For example, Wisdom, Downs, and Loewenstein (2010) found that when dieters were not given caloric information, they were significantly more likely to order a low-calorie sandwich than non-dieters, but when caloric information was present, dieters were significantly *less* likely to order a low-calorie sandwich. One explanation for the seeming incongruence may be that to achieve their goal of losing weight, dieters may exaggerate the caloric value of food items to motivate themselves to choose lower calorie foods. In providing them with the actual caloric information, the calories may indeed be less than expected, diminishing the threat of the previously off-limit items and permitting their purchase, perhaps without much recognition that the calories purchased are greater than they would otherwise have been (Downs, Loewenstein, & Wisdom, 2009).

In sum, the impact of caloric-labeling methods varies across settings—workplace cafeterias, fast-food chains, family restaurants—and labeling format—calories, full nutritional information, healthy menu icons—as well as demographic factors like age and socioeconomic

status (Bassett et al., 2008; Bollinger et al., 2010; Burton, Creyer, Kees, & Huggins, 2006; Chu, Frongillo, Jones, & Kaye, 2009; Pulos & Leng, 2010). Thus, with respect to obesity, it appears that nutrition information, like changes in pricing, may have unintended effects or, at best, only yield small changes in caloric consumption at the individual level. In the aggregate, of course, it is possible that small changes could yield a positive impact across the population as a whole; however, even this remains to be seen. Consequently, we believe that a singular focus on such methods may delay evaluation and implementation of potentially more effective techniques and substantive policies (Loewenstein, 2011).<sup>14</sup>

### **Why these Efforts are Insufficient: Insights from Behavioral Decision Theory**

There are many reasons why price changes and improved access to information, both of which appeal to rational decision making processes, might not improve diet. To understand this, we will now consider and elaborate on several concepts and biases from behavioral decision theory, a descriptive theory of decision making that examines how people actually make decisions, which often differs from the normative theory of rational decision making (Simon, 1955; Slovic, Fischhoff, & Lichtenstein, 1977).

### **Cognitive Processing Limitations**

People's ability and capacity to process information is limited; the larger the amount of information to process, the greater the demand for cognitive resources and the higher the

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<sup>14</sup> Despite our criticism of nutrition labeling, we do believe it serves an important function in the United States obesity epidemic. However, we see its main contributions as being on the supply side rather than the demand side of the equation. The nutritional content of food, especially pre-prepared foods, can be difficult to accurately estimate and might be considered a more hidden attribute. Mandatory calorie postings and nutrition disclosure serves as a form of forced health transparency which can put pressure on food producers and manufacturers—both the food and beverage industry and the restaurant industry—to develop products of nutritional merit ("Counting calories is a tricky business," 2011).

potential for cognitive overload (Draycott & Kline, 1996; Norman & Bobrow, 1975; Simon, 1955). When people must devote too many cognitive resources to a decision and are in a state of high “cognitive load,” they are significantly more likely to choose something of short-term pleasure rather than long-term benefit. For example, participants in a study who were tasked with remembering a longer series of numbers while engaging in other tasks were significantly more likely to choose a slice of chocolate cake over fruit salad in a subsequent dining decision than those needing to recall a shorter sequences of numbers (Shiv & Fedorikhin, 1999). People may have succeeded in remembering the numbers, but the cost may have been more calories than they would otherwise have chosen.

### **Confirmation Bias**

These cognitive limitations suggest that more information can be distracting and actually lead to suboptimal decisions rather than the most optimal ones (Gourville & Soman, 2005; Marois & Ivanoff, 2005; Simon, 1955). Moreover, decision makers who deliberate excessively are more likely to base their decisions on less relevant criteria (Wilson & Schooler, 1991). Or, in contrast, they seek out only the evidence that supports their belief or position to the exclusion of contradictory or ambiguous information (Baron, 2000; Kunda, 1999; Nickerson, 1998; Plous, 1993). This “confirmation bias” would persist despite the provision of additional information.

### **Positive Illusions and Optimism Bias**

Even when people reportedly comprehend the information, they often have positive, self-enhancing illusions about themselves, potentially leading them to believe they are less likely to experience a negative outcome than others (Taylor & Brown, 1988). Such cognitions may arise from a tendency to protect one’s self-worth (Weinstein, 1989), from past personal experiences or

lack thereof (Tversky & Kahneman, 1974; Weinstein, 1980), or from the dominant societal depiction and stereotype of an at-risk individual (Weinstein, 1980; Weinstein & Klein, 1995). Regardless of the underlying cause, positive illusions about the self may consequently lead the individual to discount the relevance of such information to them personally and, consciously or unconsciously, to deny the need for behavior change (Frewer, Shepherd, & Sparks, 1994; Miles & Scaife, 2003). Recent research within the dietary domain suggests that this optimism bias can cause people to overestimate their capacity for self-control, thereby exhibiting another bias, the self-restraint bias, which leads people to put themselves in more tempting situations than they can resist (Nordgren, van Harreveld, & van der Pligt, 2009).

### **Status Quo Bias**

Additionally, health information, even when it is acknowledged as true and relevant for oneself, may not lead to behavior change. People display a status quo bias, a strong tendency to maintain their current behavioral patterns even if they have learned that better behavior choices exist (Samuelson & Zeckhauser, 1988). They also often rely on heuristics or rules of thumb to dictate their choices, which do not involve rational calculation.

### **The Idiosyncratic Nature of Dietary Behavior: Food and Behavioral Decision Theory**

The limitations stemming from the aforementioned cognitive biases and heuristics are hopefully clear. To this, we must add a bit about what may reasonably be termed the idiosyncratic nature of dietary behavior—specific characteristics of this domain that make it, perhaps by its very nature, even more susceptible to biases.

## **Calorie Allocation, Mental Accounting, and Misestimating**

Decisions about what to eat and when are ever-reoccurring, due to the continual energy expenditure draining the body of the energy that food consumption provides. This repeated, usually daily process of consumption and expenditure calls for a unique form of decision making, unlike any other human behavior, even sleep or exercise. To ensure the body is running at an optimal level, at least a certain amount of calories must be consumed—every day, throughout the day.

In a sense, we have an optimal daily allotment of calories to consume each day. The recommended daily allowance, the number of calories that are needed for proper functioning, is partially under an individual's control and can be increased most typically by raising energy expenditure through exercise or physical exertion. A unique aspect of this decision making is that the decision to consume calories is not just a repeated decision, but in our modern society, an ever-present possibility and decision to be made. Furthermore, to a certain extent, the intake of calories—and therefore the decision making—must occur at least periodically. If one consumes too many calories all-at-once or too quickly, there will be repercussions in the future, either in the form of feeling sick in the immediate future, feeling hungry in the later future, or experiencing weight gain in the still distant future. If one consumes too few calories or goes for an extended period of time without eating, one will feel hungry in the immediate future, feel weak and lethargic in the later future, or experience weight loss and muscle loss in the more



distant future.<sup>15</sup> Thus, calorie allocation and “required” consumption occurs now and in the future, innumerable times.

Since calorie allocation is necessary in the present and near future and more distant future, and so on, it is an unusual decision process, constantly requiring a tradeoff between the present and the future, susceptible to both intertemporal discounting and hyperbolic discounting. The content and timing of future meals is not always known; consequently, the amount to consume right now is not always evident since the future meal may be more valuable in terms of taste, visual appeal, price, surrounding ambiance, or company shared. So the tradeoff between current and future food consumption is not an obvious comparison.

In this same vein of uncertainty, people do not always have perfect information regarding the ways they choose to allocate their calories. For example, caloric intake can end up being disappointing, as when ordering a meal at a restaurant that turns out to be disagreeable to the taste but one eats it, perhaps due to the inevitable financial cost incurred or for fear of offending the chef or present company. Or when one finds oneself in a moment of necessary and required calorie consumption due to hunger but has limited options available, like a vending machine. However, even when a person chooses to allocate his calories in a way that is pleasing, a common problem arises in misestimating the calories contained in the food, as even health professionals have been shown to misestimate the caloric content of entrées by 200 to 600 calories (Berman & Lavizzo-Mourey, 2008). The calories consumed do not always feel like the amount (as many or as few) of calories that are consumed, due to a variety of factors including the caloric density of food, the volume of food, and the time required for food consumption.

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<sup>15</sup> Caloric requirements and the optimal daily allotment of calories change with weight changes and naturally increase with weight gain (and decrease with weight loss) in order to sustain a given weight increase (decrease) (Hall et al., 2011).

## **Visceral and Present-Biased**

Hunger, specifically in this case the need for food, is, as Loewenstein (1996) highlights, a visceral state. And other visceral aspects, such as emotional states, might potentially interact with hunger fulfillment choices due to mutual visceral attributes. Mood may unknowingly influence dietary choices and food may be consumed specifically to adjust the current affective state. In other words, people may eat to reduce stress and tension or to compensate for uncomfortable negative emotions like sadness, fear, or anger. Visceral states like hunger demonstrate our inherent present-biased preferences whereby, in the moment of decision, people are susceptible to food decisions “overwhelming” them, distorting the perceived utility of various forms of compensation (Loewenstein, 1996; O'Donoghue & Rabin, 1999). That which most satisfies the visceral needs of the present receives greater weight than that which offers potential future benefits (O'Donoghue & Rabin, 1999). Such an internal state can evoke intrapersonal conflict, whereby a short-term, viscerally appealing choice is preferred but may be in opposition to long-term goals and interests of the “future self.”

## **Dynamic Inconsistency and Hyperbolic Discounting**

Such preferences, however, are not consistent for time spans of equal duration. People value the present to a large extent over the near future, such that they would be willing to accept a smaller offering today (e.g., a few bites of chocolate cake today) rather than delaying satisfaction for a larger offer in the future (e.g., a slice of chocolate cake tomorrow). However, people express a preference for waiting for the larger offer if the time is far in the future. For example, if asked about choosing between a few bites of cake in a week or a slice in a week and one day, most people would choose the slice. The time difference between the bites of cake

versus the entire slice is one day in each of the scenarios. Yet, a block of time in the present, in a sense, feels like a larger span of time than the same block of time in the future. This tendency to discount the difference between the present and the near future more than a similar time difference occurring in the distant future has been termed hyperbolic discounting (Read & van Leeuwen, 1998). Hyperbolic discounting leads to dynamically inconsistent preferences, as today a mere few bites of chocolate cake is preferred over a (larger) slice tomorrow, but in the more distant future (a week), the preferences reverse as the slice is an easier choice to make and clearly preferred. Thus, our bias for the present and tendency towards hyperbolic discounting appear particularly relevant to the nature of food, given the visceral problem of hunger which food satisfies in the present moment while a future hunger state seems less urgent.

Furthermore, while from a caloric perspective it may seem beneficial to eat just a few bites of cake in the present rather than a whole slice in the future, hyperbolic discounting is problematic in that one always tends to prefer to eat a few bites in the present—every present—than postpone gratification for the future. Postponing for the future is beneficial on numerous levels, not the least of which is that by the time the future arrives, one might have become so engrossed in another activity that the desired slice of cake is forgotten or the desire subsided to point where the food—and calories—are willingly forgone.

### **Inter-temporal Discounting**

Moreover, the visceral problem of hunger, which food satisfies, requires self-control and restraint in choosing between two options for present consumption, again, largely owing to our bias for present satisfaction. For instance, a choice in the present between a few bites of chocolate cake and a few bites of fruit, requires weighing the importance of future health alongside a tempting and tasty, but unhealthy option, especially if one is confronted with such a

choice repeatedly. It is reasonable to believe that we might eat a few bites of chocolate cake now, telling ourselves that we will have a bit of fruit later—rather than eating a few more bites of chocolate cake later. In this way, not only do we exhibit hyperbolic discounting in preferring a tempting selection now over a better, tempting selection in the future, but we also discount intertemporally, desiring the tempting selection now over a healthier selection, believing that in the future, we will choose the opposite. Thus, we may profess to value good health, but prefer to eat unhealthfully today, as there is always tomorrow to eat more healthfully. But people often mispredict how they will act, what they will decide, and how they will feel in the future. That is to say, they do not know their future selves very well (Gilbert, Pinel, Wilson, Blumberg, & Wheatley, 1998; Soman, 1998; Zauberman, 2003; Zauberman & Lynch, 2005).

### **Continual, Repeated Choices, Separated by Time**

Such an internal conflict between one's present self and future self is further complicated by the cyclical, temporal nature of food consumption—that intake occurred in the recent past and will occur again in the not-too-distant future—and this will, by necessity, repeat regularly multiple times a day, every day. In the present, food decisions may be influenced by perceptions of past consumption (Shide & Rolls, 1995; Wansink & Chandon, 2006) as well as expected future consumption; the former is problematic for a variety of reasons including faulty memory and the latter troublesome owing to biases associated with future perceptions like poor forecasting abilities. Moreover, the decision making concerning food selection across a day or week must take place without all the food items being present and absent conscious deliberation and calculation of nutrients.

Similarly, decisions regarding food consumption are distributed over time, meaning that the marginal impact of each decision occasion is negligible. Consequently, people tend to

neglect the consequences of these dispersed decisions as they only manifest themselves in the aggregate (Herrnstein & Prelec, 1991). And that is when the significance of all the cumulative small decisions becomes apparent.

Further, when people view decisions as the only decision of its kind, that is, they view the choice as an isolated, one-time choice, they tend to choose more virtuous options (Khan & Dhar, 2006, 2007). But when they perceive the decision as the first in a series of similar decisions, they tend to choose less virtuous choices—choosing more “want” than “should” options. And in fact, when participants in a study were told they would be selecting a snack for immediate consumption and later have the opportunity to choose another snack, they chose a less healthful snack in the present (Khan & Dhar, 2006). This seems reasonable in the moment as, if a choice is of a repeated type, one is able to offset the guilt associated with impulsive behavior by anticipating that the future self can and would make more virtuous choices. However, the future self, when the future arrives, acts and feels much like the present self had acted and felt—meaning that the “want” option is usually always more desirable than the “should” option.

### **External Factors: From Problematic Marketing to Helpful Nudging**

While the internal nature and dynamics of dietary behavior make navigating healthful food choices difficult, especially in our food abundant society, we would be remiss if we did not cite external elements like the informational asymmetry between marketers and individuals that further signal the ultimate insufficiency of traditional mechanisms like health information and price changes. Through research, marketers can predict consumers’ responses to various environments, of which the individual customer is unaware. Companies can then leverage this information to craft ever-more sophisticated environments that respond to customers’ food

behavioral tendencies and maximize profits (Just & Payne, 2009). Thus, the food landscape is continually changing and improving in its ability to appeal to consumers. Corporate marketing dollars far out-pace the finances available to re-educate consumers: The fast-food industry alone spent over \$4 billion in marketing dollars in 2009 while the Department of Agriculture's Center for Nutrition Policy and Promotion requested \$13 million from the federal government for its 2012 budget. This is roughly a third of a percent of the amount the fast food giants spend to market to consumers (Bittman, 2011).

Aside from limiting choices which could have its own consequences, one logical conclusion would be to, like marketers, understand human behavior and use psychology to move people towards making healthier choices (Just & Payne, 2009). Such a concept, which has been labeled "asymmetric paternalism" or "libertarian paternalism," involves using these natural biases and heuristics to guide people ("asymmetrically") towards beneficial behaviors without denying people the right to choose (as espoused by "libertarians") (Camerer, Issacharoff, Loewenstein, O'Donoghue, & Rabin, 2003; Downs et al., 2009; Loewenstein, Brennan, & Volpp, 2007; Sunstein & Thaler, 2003; Wisdom et al., 2010). This amounts to essentially "nudging" people towards decisions that are in their best interests by carefully structuring choices in a way that recognizes and then offsets cognitive biases and human idiosyncrasies (Johnson et al., 2012; Levy, Riis, Sonnenberg, Barracough, & Thorndike, 2012; Oliver, 2011; Schlag, 2010; Thaler & Sunstein, 2008; Thorndike, Sonnenberg, Riis, Barracough, & Levy, 2012). This behavior of designing the decision environment is tantamount to acting as a "choice architect" (Thaler & Sunstein, 2008).

For example, the aforementioned status quo bias suggests that if a healthy option were made the default, then the tendency not to deviate from the default would work in favor of one's

health (Samuelson & Zeckhauser, 1988). This has proven successful in the financial domain as one company saw initial enrollment in 401(k) plans skyrocket from 49% to 86% after its system changed from opt-in to automatic enrollment (Madrian & Shea, 2001). Moreover, there is evidence of the impact of defaults in medical decisions, even ones which are arguably mostly altruistic like organ donations. European countries with opt-in systems have between 4-28% participation while those with opt-out systems enroll 86-100% of citizens (Johnson & Goldstein, 2003).

That decision biases seem to impact decisions like organ donation, which are of great consequence but occur only occasionally and whose infrequent occurrence might seem to necessitate greater deliberation, suggests that more mundane, quotidian decisions like dietary choices may be even more susceptible to the influence of cognitive biases, especially given that people make on average 226.7 food decisions *every* day (Wansink & Sobal, 2007). The sheer number of decisions, which alone precludes complete critical analyses, would suggest as much but the apparent lack of awareness that accompanies many of them further indicates the likely success of biases—as people estimate making less than 10% of the daily food decisions that they actually do (Wansink & Sobal, 2007).<sup>16</sup> In support of this, basic environmental factors have been shown to impact dietary behavior in significant and perhaps surprising ways. For instance, the size of packages, plates, serving bowls, and pantries has been shown to affect the amount of food a person serves and consumes by up to 45% (Sobal & Wansink, 2007; Wansink, 2006;

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<sup>16</sup> In a survey, people were asked to estimate the number of food decisions they made in a given day with the average response being 14.4 decisions. Following this question, they were prompted to respond to specific questions regarding their meals, snacks, and beverages that related to the “when,” “where,” “what,” “how much”, and “who” for each of these food decisions. Given this more detailed question, the average number of food-related decisions each day was 226.7. Thus, the initial estimate of just 14.4 decisions was less than 10% of actual food decisions made throughout the day. At least part of the disparity in the two estimates can be attributed to people categorizing only the decisions surrounding food choice, that is, the decision of what food to eat, as true food decisions. Even so, respondents tended to average 59 decisions related to food choice, which is still much higher than the 14.4 estimate (Wansink & Sobal, 2007).

Wansink, van Ittersum, & Painter, 2006). The placement of food items in a buffet line, whether French fries or steamed broccoli appear first, or the layout of a cafeteria, which might place a salad bar or snack display near the checkout line, has implications for foot traffic patterns and ultimately purchasing behavior. The mere visibility of food products, such as storing ice cream in a freezer with an opaque top or placing chocolate milk cartons behind plain milk cartons in a school cafeteria, has been shown to affect sales (Just & Payne, 2009; Levitz, 1976; Meyers, Stunkard, & Coll, 1980; Wansink, 2006). Similarly, making items more or less accessible—by moving vending machines away from an eating area or placing pitchers of water directly onto an eating surface—also significantly influences intake (Meiselman, Hedderley, Staddon, Pierson, & Symonds, 1994; Meyers et al., 1980). And even serving unshelled almonds rather than ready-to-eat, shelled almonds leads to a reduction in the amount that people choose to consume due to the additional time or effort required to remove the shells (Schachter & Friedman, 1974).

If such external factors are powerful enough to alter and reverse initial preferences, then the process of making a decision may be partially responsible for shaping preferences, including dietary ones (Hsee, 1996; Hsee, Loewenstein, Blount, & Bazerman, 1999; Just & Payne, 2009; Payne, Bettman, & Johnson, 1993; Shafir & LeBoeuf, 2002; Slovic, 1995). Moreover, subtle changes in the choice context are capable of shifting people's choices precisely because of the unconscious decision biases to which people are susceptible. However, outside of studies related to changes in the decision environment or operational cues mentioned in the preceding paragraph, few behavioral interventions related to dietary matters have explored using decision biases to encourage healthful eating, especially in a real dining setting. Thus, we suggest that biases inherent in individual dietary behaviors are a suitable and indeed, necessary, topic for study.



The current research is motivated primarily by the lack of empirically tested examples in this domain and the powerful effects found in other domains. Additionally, few health behavior interventions have been explicitly theory-based, failing to offer a deeper understanding of the causal mechanisms responsible for their effectiveness. As such, they remain limited in their application and potential to design other interventions. To this end, the current work hopes to advance an understanding of health behavior by integrating psychological theory and practice and offering a respectful collaboration between researchers and practitioners in health and behavioral disciplines (Barker & Swift, 2009).

### **Current Research: Theory and Hypotheses**

The current research seeks to assess the effectiveness of a variety of interventions—each of which is associated with a different psychological mechanism that has been shown to influence decision making—in influencing dietary decisions and encouraging healthy food purchases. A number of interventions are tested along with the two predominant approaches most widely discussed, namely price changes and nutrition labeling, in hopes of comparing the methods to each other.

To this end, our primary research question is as follows:

*Research Question: What are effective methods of encouraging healthy eating in a workplace cafeteria and how do new, previously untested methods compare to those primarily recommended (ie: price changes and nutritional information)?*

In a 21-month long field study, we study nine different interventions sequentially in a hospital cafeteria to determine the effectiveness of each in encouraging sales of healthful items. Our interventions include price changes (economic), colored-nutrition labeling (cognitive), novel

framing of caloric health messages (cognitive), pairings of unhealthful and healthful substitutable items (environmental), grouping of items by healthfulness (environmental), normative messages about the purchases of cafeteria patrons (social), and smiley- and frowny-face labeling on food items (affective). For our data analysis, we analyze cafeteria register receipts, focusing on sales of beverages, chips, and fruit and specifically on the percentage of healthful items sold.

Below we provide the theory behind each intervention and the corresponding hypotheses.

### **Economic Interventions: Price Changes**

While we presented evidence indicating the limited impact of price changes on obesity, there is certainly evidence that consumer behavior in general is impacted by price (Dickson & Sawyer, 1990). To compare the effectiveness of alternative interventions to price changes, we assess the impact of price changes in this study. While price changes of different magnitudes may yield demand changes of differing degrees, we are unable to alter price on the same items repeatedly in the research site. However, it is possible to change the price of one set of items at one point in time, for instance bottled sugary soft drinks, and to later change the price of another set of similar items like bottled water. Thus, two price interventions take place on two separate sets of items as opposed to a series of price changes on the same set of items to assess price elasticities.

Moreover, the choice of soft drinks and water are not arbitrary; according to 2009 industry data, Americans drank 13.8 billion gallons of soda and other sugary, high-calorie, nutrient-lacking beverages like punch sports drinks and sweet tea (Kaplan, 2012). That is the equivalent of 70,000 calories per person, which research suggests is arguably a contributing factor to the obesity crisis (Kaplan, 2012; Malik, Schulze, & Hu, 2006; Olsen & Heitmann, 2009). Other data suggests that regular soft drinks represent 7% of overall energy intake in

adults, with consumption increasing by almost 500% over the past 50 years (Block, 2004; Putnam & Allshouse, 1999).<sup>17, 18</sup> Reducing soda consumption has been suggested to be one of the most defined ways of reducing obesity partially as evidence mounts that the body does not recognize the calories in beverages to the extent it does for those coming from solid foods, possibly due to greater satiety effects (Chen et al., 2009; de Graaf, 2011; DiMeglio & Mattes, 2000; Martens, Lemmens, Born, & Westerterp-Plantenga, 2011; Viskaal-van Dongen, Kok, & de Graaf, 2011). Moreover, a maintained caloric reduction of 100 calories per day—less than a 12-ounce can of regular soda—could preclude weight gain for 9 out of 10 adults in the United States (Hill, Wyatt, Reed, & Peters, 2003; Novak & Brownell, 2011; Sturm, Powell, Chriqui, & Chaloupka, 2010). Furthermore, soft drinks have a higher price elasticity than almost any other food or beverages, with an elasticity estimated at .8-.1, indicating that for every 10% increase in price, consumption should decrease 8-10%.<sup>19</sup> Consequently, a price intervention on soft drinks may be one of the best candidates in terms of a specific food or beverage target that would both affect purchasing behavior and reduce caloric intake (Andreyeva et al., 2010; Wang, 2010).<sup>20</sup> Similarly, increasing water consumption has been suggested to be beneficial for health in general, as well as for weight reduction (Stookey, Constant, Popkin, & Gardner, 2008). And

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<sup>17</sup> There is evidence of recent reductions in soda consumption among some demographics; however, consumption levels still exceed recommended levels such that further reduction is needed (Welsh, Sharma, Grellinger, & Vos, 2011).

<sup>18</sup> As compared to adults, who are our population of interest, youth ages 2-19 receive roughly 10-16% of their daily caloric intake from consumption of soft drinks and 100% fruit juice (Wang, Bleich, & Gortmaker, 2008).

<sup>19</sup> However, in a recent study in a hospital cafeteria, a 35% increase in price was associated with a 26% decrease in sales, indicating a slightly more inelastic demand than prior work, as Andreyeva et al. (2010) would have predicted a 28%-35% decrease in sales (Block, Chandra, McManus, & Willett, 2010).

<sup>20</sup> Even greater price elasticity estimates for specific soft drinks have been estimated, like  $\square 3.8$  for Coca-Cola and  $\square 4.4$  for Mountain Dew; however, these estimates have not been rigorously evaluated and may be inaccurate (Wang, 2010).

substituting water for soda would be an ideal behavior change (Stookey, Constant, Gardner, & Popkin, 2007; Wang, Ludwig, Sonnevile, & Gortmaker, 2009).

Although several studies have measured the caloric impact of substituting sugar-sweetened beverages with water as opposed to alternative beverages, understanding of actual consumer behavior and beverage choice in relation to a tax on sugar-sweetened beverages remains limited (Stookey et al., 2007; Wang et al., 2009; Wang, 2010). In a study using 6 years of panel data to estimate substitution with cross-price elasticities, Dharmasena and Capps (2009) found that a 1% increase in the price of soft drinks resulted in a decrease in soft drink (1.9%) and diet soft drink (0.49%) purchases as well as an increase in bottled water (0.07%), low-fat milk (0.29%), high-fat milk (0.49%), coffee (0.30%), and fruit juices (1.15%). Although the rate of substitution from regular soft drinks to water did not appear high in the aforementioned study, many soda tax advocates assume that an 18-20% increase in soda taxes would result in more than 30% of current soda consumption switching to water. However, evidence for such assumptions appears insufficient to date (Fletcher, 2011).

The specific price changes include first raising the price of 20-ounce sugary soft drinks from \$1.50 to \$1.75, a 25-cent or approximately 16.7% price increase.<sup>21</sup> A later intervention reduces the price of bottled water beverages from \$1.50 to \$1.25, a 25-cent or approximately 16.7% price decrease. Such price changes occur in the experimental cafeteria as well as the other food outlets and the vending machines.

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<sup>21</sup> We price diet soft drinks less than regular soft drinks while being mindful of concerns in the health community regarding the safety of diet soft drinks and more specifically, artificial sweeteners. We do so believing there is greater evidence of increased health risks from consuming sugar-sweetened beverages and therefore aim to reduce consumption of these beverages and encourage the substitution with other beverages, including diet soft drinks. There are health experts who believe moderate consumption of diet drinks to be a safe and healthy alternative to regular sugar-sweetened beverages (de Koning, Malik, Rimm, Willett, & Hu, 2011).

This particular price increase on soft drinks is not without justification. Taxes have been discussed in terms of a per-ounce tax and also a percentage increase over the current price. A penny-per-ounce tax on sugar-sweetened beverages (SSBs) implemented nationally is predicted to decrease consumption nearly one-fourth while also ushering in at least \$13 billion a year in income (Andreyyeva, Chaloupka, & Brownell, 2011).<sup>22</sup> Another study suggested that the tax would reduce consumption among adults ages 25-64 by 15 percent, and over a ten year period, it would lead to the prevention of 2.6% of new cases of diabetes, nearly 100,000 coronary heart events and over 26,000 premature deaths while avoiding more than \$17 billion in medical expenditures (Kaplan, 2012; Wang, Coxson, Shen, Goldman, & Bibbins-Domingo, 2012). Alternatively, those speaking in terms of a percentage price increase on SSB believe that a 20% price increase on SSB nationally could equate to a 20% decrease in consumption, which in the next decade could save about \$30 billion while preventing 400,000 new cases of diabetes and 1.5 million people from being medically defined as obese (Bittman, 2011). Numerous studies report similar things for a tax of similar amounts on sugar-sweetened beverages (Andreyyeva et al., 2011; Finkelstein et al., 2012; Jacobson & Brownell, 2000; Novak & Brownell, 2011; Roehr, 2009; Sturm et al., 2010).

However, research similar to ours in a hospital cafeteria reported significant decreases in sales of sugary soft drinks when prices were increased by 35%, which amounted to a 45-cent price increase in that cafeteria (Block et al., 2010). Such a price change is far greater than those that have been discussed in the political sphere and may be even less feasible than more moderate price hikes. As such, we believe it important to study the effects of a smaller price

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<sup>22</sup> Another study suggested that a penny-per-ounce tax in just the state of New York would garner \$1 billion annually and produce meaningful health care gains over the course of a decade by saving \$3 billion in health care costs and preventing 37,000 new diabetes cases (Bittman, 2011; Wang, 2010).

increase. Our placement of a 25-cent price increase on a 20-ounce soda originally priced at \$1.50 amounts to a 1.25-cent tax per ounce or 16.6% price increase. Such a price is slightly above the widely discussed penny-per-ounce tax and slightly below the aforementioned 20% price increase. Consequently, we have positioned our research in the middle of the political debate.<sup>23</sup>

*H1: Increasing the price of less healthful foods, specifically sugar-sweetened soft drinks, will decrease the sales of those items and increase the sales of more healthful items.*

Our price decrease on bottled water has been less discussed in the extant research or political discourse surrounding food taxes and subsidies. We know of only one other study similar to ours that looks at a price decrease for beverages, that of Jue et al. (2012), and they decreased the price of all non-calorie beverages (water and diet beverages) by an average of 13 cents (10% price decrease). They did not find any difference in sales with this price change; when a sign was added explaining the price change (“Lighten up for less— 10% off all zero-calorie bottled beverages and water”), sales of non-calorie beverages did increase (Jue et al., 2012, p. 630). Instead, we chose to decrease the price of bottled water by 25 cents, mirroring the 25-cent price increase on sugary soft drinks and showing the effects of a price change of the same size in both directions. In addition, some research suggests that a 30-40% price difference is most effective; our regular soda priced at \$1.75 is almost 30% more than our \$1.25 water (French, 2003; French et al., 1997; Hannan, French, Story, & Fulkerson, 2002; Liebert et al., 2012).

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<sup>23</sup> The price increase that we propose, which is tantamount to a 1.25 cent-per-ounce tax or a 16.6% increase in price, would provide the state of Ohio with over \$400 million in annual revenue; if our price change were implemented nationally it would generate over \$10 billion in funds annually (Andreyeva et al., 2011; "Revenue calculator for sugar-sweetened beverage taxes," 2011).

*H2: Decreasing the price of more healthful foods, specifically bottled water, will increase the sales of those items and decrease the sales of less healthful items.*

## **Cognitive Interventions**

**Colored-nutrition labeling: Simple nutritional information cues.** As we have suggested earlier in the paper, people are not always rational and do not always act in accordance with the knowledge they have, so focusing on the nutrition labeling and the provision of health information may not be the most effective means of affecting consumer food purchases. However, as it is one of the primary policy efforts used to target an individual's dietary decisions, it is important to evaluate alongside the methods that we are suggesting. Moreover, when consumers do act and make decisions in a rational manner, having at least a basic understanding of nutrition and dietary concerns can be helpful in achieving goals (Ratner et al., 2008). But again, nutritional information, often changing and expanding with new research, can seem complex and overwhelming and thus, consumers need assistance parsing the material.

Given this, research has shown that the extent to which different nutrition labels and health symbols are understood and thought to convey health information varies widely. For the purposes of this study, we use a particular "traffic light" labeling system that appears to be better understood than other forms (Balcombe, Fraser, & Falco, 2010; Borgmeier & Westenhoefer, 2009; Lobstein & Davies, 2009). The system, which we refer to as colored-nutrition labeling and discuss in greater depth in the methods section of this paper, uses a green-yellow-red labeling system to indicate the healthfulness of different food items, with green being the most healthful, then yellow, then red. The healthfulness of individual food items is based on caloric, fat, saturated fat, trans fat, cholesterol, sodium, and sugar content. Aside from evidence that the "traffic light" method is easily understood by consumers, it seems particularly useful in a

worksite cafeteria setting where patrons may be pressed for time and need easily identifiable and evaluable health information. Simplifying health information into a three-colored system should allow for rapid communication of the healthfulness of various items.

*H3: When provided a health-indicator (or health information) in the simplified form of colored-nutrition labels, purchases in the healthiest (“green”) category and moderately healthy (“yellow”) category will increase compared to the least healthy (“red”) category and will make up a larger proportion of total purchases.*

**Health message framing.** Health messages used in past research have focused on highlighting either the benefit of following the information or the cost of disregarding it (Kahneman & Tversky, 1979). There is evidence that different informative statements are effective in different situations and appear to depend on the level of risk associated with a particular type of behavior.

With regards to health behaviors, it is helpful to first differentiate between two perhaps psychologically distinct types of health behaviors, prevention and detection. Prevention behaviors, like applying sunscreen when planning to be out in the sun, are undertaken to prevent the onset of a health problem. Given that they are, by definition, performed to prevent and minimize the likelihood of certain poor health outcomes, they are assumed to involve minimal risk in themselves or at least lower risk than the health state they are intended to prevent, as sunscreen is worn to protect against skin cancer.<sup>24</sup> The “low risk” associated with preventative

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<sup>24</sup> It can, of course, be argued that certain prevention behaviors carry greater risk than others, such as vaccines, which may make a person sick, but are used ultimately to decrease the likelihood of experiencing an especially bad health outcome. Although a reaction to a vaccine may be as bad as the primary, focal illness that it seeks to prevent, the risk of the vaccine is assumed due to the lower probability of a reaction or the small likelihood of experiencing a health outcome that is as severe as that related to the primary, focal illness. However, despite the “risk” of such



behaviors suggests that these actions have a greater potential to benefit the individual than to harm him: The likelihood of a positive or neutral outcome is much greater than the likelihood of a negative outcome. Given this greater likelihood and higher certainty for good to come from preventative behaviors, and that people value good outcomes that have a high amount of certainty, preventative behaviors can be most convincing when the potential benefits of such a low-risk action are emphasized (Latimer, Salovey, & Rothman, 2007). An example of this might be, “If you use sunscreen, you will help to protect yourself from skin cancer and keep your skin looking youthful” (Detweiler, Bedell, Salovey, Pronin, & Rothman, 1999).

In contrast to prevention behaviors, detection behaviors, like routine mammograms, are performed to discover early signs of a disease and increase the likelihood of a good prognosis by allowing for earlier, hopefully more effective, treatment. However, detection behaviors can be perceived as risky, especially in the short-term, given that testing can reveal health problems which may involve serious courses of treatments such as when a mammogram reveals a potentially cancerous lump.<sup>25</sup> The “greater risk” associated with detective behaviors as compared with preventative behaviors comes from the possibility and inherent uncertainty of attaining a negative outcome, experiencing a loss of sorts, as a result of the behavior. But we also know that people are especially averse to experiencing losses, which a negative health state could be considered to be, and react affectively more to a loss of a given magnitude than to a gain of the same amount. Thus, in the face of potential losses, in health or otherwise, people are

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health behaviors, the action should still be considered preventative in that the behavior is undertaken to minimize the likelihood of an even riskier state (i.e.: the primary, focal illness).

<sup>25</sup> It is worth noting that, in the long run, detection behaviors do aim to minimize risk of health problems as early detection can allow for early treatment. In this way, both prevention and detection behaviors are in the best interests of a person for her health. But in the short-term, the risk associated with detection behaviors exists in the form of new, potentially unpleasant information, which make detection behaviors feel psychologically riskier than prevention behaviors.

more willing to take action—even if it involves risk—in hopes of minimizing the loss (Kahneman & Tversky, 1979).

Given that people are “risk seeking” in the face of potential losses and willing to engage in riskier activities if it might protect them from loss, it may be more effective to stress the negative or poor outcome that might result from not undergoing (the risky) detective measures—as the risk of not engaging in them (a negative health state that might have been cured or mitigated) is higher than the risk of engaging them (receiving the news of the poor health state or presence of disease) (Banks et al., 1995; Meyerowitz & Chaiken, 1987; Rothman & Salovey, 1997; Rothman, Salovey, Antone, Keough, & Martin, 1993; Tversky & Kahneman, 1981; Wilson, Purdon, & Wallston, 1988). An example of an effective message for detection behaviors would be, “If you do not get regular mammograms, you may fail to detect cancer in a timely manner and increase your risk of mortality.”

In summary, this research suggests that people seem more likely to change their behavior when prevention messages are framed in terms of the benefits to be gained and detection messages are framed in terms of the cost of foregoing an evaluation (Detweiler et al., 1999; Gerend & Shepherd, 2007; Rothman, Martino, Bedell, Detweiler, & Salovey, 1999; Rothman & Salovey, 1997; Rothman et al., 1993; Salovey, Rothman, & Rodin, 1998). It would seem that our intention of encouraging the selection of more healthful foods and a more healthful diet involves little risk, given that the main cost is that of giving up unhealthful, but potentially tasty, foods. Dietary change in this case seems preventative in nature and would appear to best be framed in terms of the benefits to be gained by selecting healthful options, that is, the benefit of *not* eating unhealthful foods, as opposed to the costs of eating unhealthful foods or the costs of *not* eating healthful foods.

However, much of the early research on message framing, and much of the body of research itself, focuses on health behaviors outside of nutrition education. A few studies which have looked at framing and nutrition behaviors have found little effects using a gain-frame message (Fox, Hanson, Briefel, Olander, & Aldridge, 2007). For example, van Assema, Martens, Ruiter, & Brug (2001) found no difference in attitudes or intentions to eat a low-fat diet or to eat enough fruit and vegetables when using a positively framed message compared to a negatively framed one. The authors followed this research with a series of three studies that again tested a message on fat, fruit, and vegetable consumption but also included a study of more esoteric health information (flavonoid intake) and information targeting a specific group (folic acid intake for pregnant women). Again, finding no impact of framing on attitudes or behaviors, the authors concluded that gain and loss frames may have limited impact on changing precautionary motivation related to nutrition behaviors (Brug, Ruiter, & Van Assema, 2003).<sup>26</sup>

A study similar to ours in a hospital cafeteria used a health message to reduce sales of regular sodas. Block et al. (2010) tested a price change and a health message which stated, “Lose up to 15-25 pounds in one year and decrease your risk of diabetes by ½. Just skip one regular soda per day. For zero calories, try diet soda or water” (p. 1427).<sup>27</sup> While the authors made no reference to the framing literature in their paper, this prevention message clearly emphasizes the benefits or gains of a low-risk behavior—forgoing a regular soda and trying diet soda or water instead. The authors found that the education message alone did not reduce

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<sup>26</sup> In a study that provided people with computer feedback concerning their physical activity levels, researchers found that although gain-framed messages resulted in stronger intentions to be physically active compared to loss-framed messages, this did not translate into a significant increase in actual physical activity (van 't Riet, Ruiter, Werrij, & de Vries, 2010).

<sup>27</sup> We note that more recent research by Hall et al. (2011), which we discussed in an earlier footnote, suggests that the weight loss may more appropriately be approximated as 7.5 pounds per year. However, we report the wording of the message as used by Block et al. (2010).

regular soda sales. However, when they coupled the message with a price change (an increase in the price of regular sodas) that had, separately, at an earlier point in the study reduced sales significantly, the education message and price change decreased sales significantly below the level occurring from the price change alone. The authors did not speculate as to why the message alone did not alter behavior.

However, early on, Rothman and Salovey (1997) acknowledged that given the complexity and difficulty of changing health behaviors, mediating factors beyond prevention or detection situations are likely to have an impact on decision making. And dietary behavior might be too complex or more complex than other health behaviors (Fox et al., 2007).

Indeed, additional research has shown that health-related messages can be more effective in creating behavior change when they are psychologically-tailored, using information known about a targeted person or a group, such as how they process information (Aldridge, 2006; Kreuter, Farrell, Olevitch, & Brennan, 2000; Williams-Piehota et al., 2004). For example, information processing styles like one's need to spend time processing information (need for cognition), one's belief about whether he or his doctors are responsible for his health (health locus of control), or one's tendency to seek or avoid health information (monitoring and blunting styles) have all been shown to impact the effectiveness of health messages in promoting behavior change (Cacioppo, Petty, Feinstein, & Jarvis, 1996; Miller, 1987; Wallston, Wallston, & DeVellis, 1978). Other individual differences appear to impact one's receptivity to health message framing, including one's dependence on or addiction to a behavior, ambivalence about an advocated behavior, motivational sensitivity to rewards and punishment, feelings of self-efficacy, and even the discrepancy between one's self-perception and what one would have others believe (Broemer, 2002; Fucito, Latimer, Salovey, & Toll, 2010; Mann, Sherman, &

Updegraff, 2004; Myers, 2010; Sanchez, 2006; Tykocinski, Higgins, & Chaiken, 1994; Van't Riet, Ruiter, Smerecnik, & de Vries, 2010).

These conclusions regarding the nuances of individual differences and their impact on the success of framing suggest a problem specifically in settings like ours where it is not possible to assess the target group's psychological characteristics and therefore determine the most effective message frame. For our purposes of studying health messages, it may be theoretically more valuable to study an aspect of the health message that appears highly relevant but less well studied—namely, the “metric” of the nutrition information and message to be conveyed.<sup>28</sup> For instance, in the Block et al. (2010) message, they mentioned both weight loss in pounds and a reduced risk of diabetes to deter regular soda purchases alongside referencing the zero calories in an alternative like diet soda and water. It would be helpful to know what part of the message was most effective, which is not possible when 3 types of health information are combined in one message.

To that end, Bleich et al. (2011) studied the impact of three forms of caloric information on adolescent purchases of beverages in several corner stores. They compared giving people basic caloric information (250 calories), caloric information in the form of percentage of total recommended daily calories (10% of daily calories), and caloric information translated into exercise required to burn those calories (50 minutes of running). They found that providing information—any information—significantly reduced the likelihood of purchasing sugar-

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<sup>28</sup> While the Patient Protection and Affordable Care Act now mandates fast food restaurants display “clear and conspicuous” information regarding the caloric content of their foods on menu boards, the actual means of doing so are not explicitly stated (“Patient Protection and Affordable Care Act,” 2010). Although most restaurants appear to just put the calorie numbers next to the food item, there are other ways one might display such information, especially in light of people's inherent cognitive limitations, which we referenced earlier in this paper. Thus, while theoretically important, defining the best metric is also an issue of practical concern (Bleich, Herring, Flagg, & Gary-Webb, 2011).

sweetened beverages. Although the three forms of information were not significantly different from each other, it appeared that exercise information was the most effective, followed by the percentage of daily calories, and finally basic caloric information.

While the latter study did not find significant differences in the three types of information and its statistics have been criticized, recently published work by Jue et al. (2012) also tests several health messages.<sup>29</sup> In several hospital cafeterias, they study the impact of (a) a caloric message about the caloric content in sugared beverages (e.g., 260 calories in a 20-ounce bottled soda), (b) an exercise message about the amount of time needed to burn off the calories in a sugared beverage using a treadmill (e.g., 50 minutes to burn off the 260), and (c) a message that included both the caloric content and the exercise information. Only the caloric message yielded significant results, but the effect was to increase sales of sugar-sweetened beverages, the opposite of the researchers intentions. However, Bleich et al. (2011) and Jue et al. (2012) are only two studies that we are aware of that test calorie information in such novel ways, especially through the use of exercise equivalents, and we think such research deserves further attention. Thus, for our research testing health messages, it would be interesting to extend this research using a different population and a different setting and test the effectiveness of an exercise message as compared to caloric information. Given that basic caloric information in the Jue et al. (2012) study yielded the opposite effect than what we hope for, an increase in sugary beverage sales, and that the basic caloric information seemed less effective (though not

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<sup>29</sup> Bleich et al. (2011) was criticized by Sainani (2012) for an emphasis on odds ratios which led to an exaggeration of the overall effect size and for implying that a meaningful difference existed between the three caloric conditions when the data provides no such evidence. Given this, we chose to replicate a portion of Bleich et al.'s (2011) method, though in a different setting with a different population. We did not use odds ratios in our analyses.

significantly so) in Bleich et al.'s (2011) study than the percentage of daily calorie condition, we will choose to use the latter for our caloric information condition.<sup>30</sup>

*H4: In offering a health message related to caloric information to encourage healthful purchases, a message that conveys the percentage of total recommended daily calories that the item contains will decrease the sales of less healthful items and increase the sales of more healthful items.*

*H5: In offering a health message related to caloric information to encourage healthful purchases, a message that conveys the exercise required to burn off the calories of the item will decrease the sales of less healthful items and increase the sales of more healthful items.*

*H6: In offering a health message related to caloric information to encourage healthful purchases, a message conveying the exercise required to burn off the calories of the item will be more successful in encouraging healthful purchases than one that conveys the percentage of total recommended daily calories that the item contains.*

Given that we are testing two health messages, sequentially, the only intervention that we are effectively implementing twice, we offer a hypothesis of the cumulative effects of the health messages.

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<sup>30</sup> Later in this paper, when we discuss the social norm intervention, we will cite Burger & Shelton's (2011) work which pitted a social norm message against an exercise related message to encourage people to take the stairs rather than the elevator. Our choice of a health message related to exercise, alongside the social norm intervention we discuss later, helps to extend Burger & Shelton's (2011) work.

*H7: In offering two sequential health messages, we expect the second message to significantly increase sales when compared with the time period just prior to the first health message.*

## **Environmental Interventions**

**Healthy substitute pairing: Joint evaluation of options.** Consumers are thought to construct heuristics and decision making strategies that are highly context dependent (Belk, 1975). This suggests that the environment partially determines the mental shortcuts and strategies used (Belk, 1975; Bettman, Luce, & Payne, 1998). And, as we discussed earlier, consumer choice itself is often modified by specific environmental factors and the choice architecture related to the situation such as the arrangement of the food items and characteristics of the actual options (Just & Payne, 2009; Levy et al., 2012; Thaler & Sunstein, 2008; Thorndike et al., 2012; Wansink, 2006). The size of a plate or popcorn bucket, the amount of variety at a buffet, the distance one has to walk to the office candy bowl and the type of container—clear or opaque—in which those treats are stored all influence people’s consumption patterns even though people are often convinced such features of the choice environment do not affect them (Severson, 2006; Wansink, 2006). The ease of introducing such environmental or structural changes coupled with their effectiveness in impacting choice selection suggests that making changes to the food environment may be one of the more fruitful avenues to changing consumer dietary choices as compared with trying to change the mind of the consumer directly (Wansink, 2006).

However, much of the existing food psychology research has focused on food environments and given the heavy emphasis on this particular domain, we choose to contrast an idea from behavioral theory that has yet to be explored in this type of research with the more



traditional spatial concept that has been thoroughly documented elsewhere in food psychology research. We juxtapose the two literatures and the hypotheses in this section and the next.

One body of research shows that when two choices are evaluated jointly rather than separately, preferences may reverse—such that the item rated more highly in separate evaluation may be rated lower than the other item when the two are evaluated side-by-side. When evaluating items individually, there is no basis of comparison and short-term desires and impulses may have great strength given there is little to force a cost-benefit analysis. In contrast, when two choices are evaluated jointly rather than separately, the joint evaluation of the two prompts a more reasoned, rational analysis as there is a choice that must be made between the two items. This choice is obvious in joint evaluation as the two options are presented; however, in separate evaluation, while there is still a choice, it is of a fundamentally different type given that the alternative to the one given option is nothing (Bazerman, Moore, Tenbrunsel, & Wade-Benzoni, 1999).

For our purposes, this might suggest that placing a desired but unhealthful item next to an alternative that is similar but more healthful may lead people to choose the more healthful option.<sup>31</sup>

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<sup>31</sup> Another theory related to evaluating two options at the same time rather than separately suggests that attributes that are particularly hard to evaluate on their own will be easier to evaluate in relation to another (Hsee, 1996; Hsee et al., 1999). For instance, when evaluating job candidates, an easy to evaluate feature (e.g., GPA) may be weighed heavily in comparison to others (e.g., specific computer skills) when looking at applicants separately; however, when looking at two resumes together, the more difficult-to-evaluate skills are easier to compare in relation to one another. In this way, the more difficult-to evaluate traits may receive more attention when choices are compared together rather than separately, and if the shift in attention and weight given to easy-to-assess and difficult-to-assess attributes is large enough, preference reversals may occur. In relation to the healthfulness of a food item and taste, at times, the latter may be a clearer or more easily evaluated standard. In this study, the healthfulness of food items will be clearly displayed and thus, the healthful dimension may be more easily evaluated than taste. In such circumstances, it is possible that under separate evaluation, healthfulness, which is the more easily evaluated attribute, would be overweighted such that the more healthful, and therefore superior, item would be chosen; while under joint evaluation, the more difficult to evaluate aspect, in this circumstance taste, would be the dimension on which to evaluate. Consequently, a tasty, unhealthful item might be chosen over a bland, healthful item. However, we would hypothesize that given the salience of the health dimension with colored-nutrition labeling, the health

*H8: When an unhealthy food (or beverage) item is placed next to a healthier substitute and clearly labeled as being alternatives with different healthfulness profiles, customers are more likely to select the healthier food item than if the unhealthy items are physically separate from the healthy alternatives.*

**Grouping by healthfulness.** In contrast to the Healthy Substitute Pairing hypothesis, an alternative approach, and indeed one that has been studied to some extent, would be a simple environmental or operational change whereby food items are arranged in a way that encouraged healthful purchases. Marketing research long ago revealed that placing items at eye level or in prominent locations like end-of-aisle displays helps to increase sales (Curhan, 1974; Frank & Massey, 1970; Sorenson, 2009; Wedel & Pieters, 2008; Wilkinson, Mason, & Paksoy, 1982). This research, of course, did not assess the location of food items in conjunction with the healthfulness of food purchases. Instead, we arranged food into smaller subsections by healthfulness. For food items within a category, such as chips, we placed all the healthful, green chips, in a section grouped together, with yellow chips in another distinct grouping and red chips in a third grouping. We made the green items most accessible, at eye level when possible and convenient to reach, but the primary manipulation involved the general separating of items in a category by level of healthfulness.

The purpose of such “healthful” spatial separation of items is that a consumer can easily narrow her options by only choosing from the green sections for the food items she desires (Belk, 1975; Bettman et al., 1998). It allows the consumer to follow easy rules of thumb or

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dimension would remain the primary dimension on which comparison would be made. This is in line with the predictions based on Bazerman and colleagues’ (1999) rational analysis explanation of joint evaluation. Still, it is an empirical question and if the findings are in the opposite direction, they will support the actual description of Hsee’s evaluability hypothesis (Hsee, 1996; Hsee et al., 1999).

heuristics like “only/primarily choose from items in the green section” or “items in the green section are the best items from which to choose.” In this way, a consumer who would like to buy a “green” sandwich need not even be tempted by sandwiches of another color or health category. Moreover, without actually restricting the choice set, this serves to spatially restrict the choice set to just green sandwiches, such that the default substitute sandwich would be another green sandwich. This, then, simplifies the decision by decreasing the choice set and theoretically increases satisfaction as choosers may be less likely to experience regret in choosing a healthful option or ruminate on counterfactuals based on health if the less healthful choices are not even in the choice set.

*H9: When foods within a category are grouped according to their healthfulness (healthy, neutral, and unhealthy), and the healthy group is displayed more prominently, the percentage of healthy items purchased will increase as compared to when food is not grouped by healthfulness.*

This hypothesis contrasts, in some senses, directly with that for the prior intervention that we discussed, whereby comparable and potentially substitutable foods are arranged in a pair, intentionally juxtaposing a less healthful option and a more healthful alternative. Although there is more research specifically in the food psychology literature in support of the latter hypothesis (H9) than the former (H8), we would suggest that, in fact, the healthy substitute pairing intervention may be the more powerful of the two.

*H10: When comparable, potentially substitutable food (or beverage) items are placed next to each other and clearly labeled as being potential alternatives with different healthfulness labeling, customers will purchase more healthful items than when foods (by*

*category) are arranged according to their colored-nutrition label in separate green, yellow, and red sections.*<sup>32</sup>

## **Social Norm Intervention**

A substantive determinant of an individual's behavior is the behavior of those around him, even behaviors that he considers inherently personal, like alcohol consumption and music preferences (Burnkrant & Cousineau, 1975; Prentice & Miller, 1993; Salganik, Dodds, & Watts, 2006). Even food choices appear to be impacted. When given the choice between a healthful and unhealthy snack, people tend to select what it appears other people had chosen as assumed from discarded wrappers. When people in a study were told that earlier people chose a healthful (unhealthful) snack, the decision maker tended to choose the healthful (unhealthful) snack as well (Burger et al., 2010). A study showed that when speaking to another person and given the

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<sup>32</sup> A further prediction is that arranging food by health category may be most helpful for people who have already decided to make healthful choices as they are able to focus on a subset of a category (like beverages), making their decision from only green or yellow items and taking red items completely out of the choice set. This simplifies the decision by decreasing the choice set and theoretically increases satisfaction as choosers have a lower likelihood of regretting a healthful choice and ruminating on counterfactuals if the less healthful choices have been removed. In contrast, for consumers who do not tend to make healthful choices or need to be reminded of healthful options, placing a healthful option next to a less healthful option forces them to make a choice—knowing that something similar to what they want is available—and they are knowingly opting for the less healthful option. In this situation, tempting someone with unhealthy foods may be helpful if the food is paired with a more healthful food that they otherwise would not have considered given their predisposition towards the unhealthy foods.

In the present study, given that we are not analyzing individual consumers, we are not able to evaluate the merits on specific types of consumers (i.e.: currently health conscious and less health conscious) of grouping by health category as opposed to the pairing of health substitutes. Nevertheless, this is an important issue of theoretical and practical importance to consider. (For instance, restaurants like McDonald's, in addition to supplying caloric and nutritional information, have made adjustments to their menu offerings in recent years. Oftentimes the new "healthful" items are grouped together in a section of the menu that highlights them as healthful. If, however, such restaurants tend to be frequented by people who are slightly less health conscious in general, and if those people need to, as we have suggested above, see comparable substitutes for the items they normally choose when looking at the menu, then it would be better to intersperse the healthful choices throughout the menu near the items they can be substituted for—rather than in a unique section of the menu. Further, to encourage customers who do not typically eat at venues with reputations for being less healthful, these restaurants might need to signal their more healthful options by grouping them in a different section of the menu). We leave this to future research, mindful that both strategies may be more or less effective for different consumer populations.

choice between two bowls of crackers, people were more likely to choose the crackers that the other person was eating and to later state they prefer those without any apparent recognition that the other person was influencing their choice (Chartrand, 2005). Other research has shown that individuals take a larger food portion after seeing another person serve a large food portion than if they watch a person take a smaller food portion (McFerran, Dahl, Fitzsimons, & Morales, 2010). However, if the person who is serving the food initially is an obese person, then the target person will serve himself a significantly smaller portion than if the initial person were of normal weight (McFerran et al., 2010). This suggests that people are influenced by multiple social dimensions: the type of food, the portion size, and the physical characteristics (or size) of another individual. In reality, food may have even more connections to social influence than other behaviors and may be one reason why some researchers believe the root of obesity lies in social and cultural forces that shape our relationship with food (Arkowitz & Lilienfeld, 2009; Hammond, 2010).

Social norms, however, can be powerful tools for behavior change. To this end, researchers have used motivation based on social comparison to influence behaviors in a variety of domains including voting (Gerber & Rogers, 2009), littering, (Cialdini, Reno, & Kallgren, 1990), recycling (Schultz, 1999), and power consumption (Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007). One widely cited study found that hotel guests significantly increased their reuse of hotel towels that were otherwise replaced daily when a pro-environmental message was combined with information relating to social norms (i.e., “75% of guests participate in our new resource savings program”) (Goldstein, Cialdini, & Griskevicius, 2008).

Recently, researchers sought to evaluate the impact of social norm information on stair versus elevator use, which might be considered a health-related behavior. They posted signs

near the elevators that either stated that most people used the stairs, a social norm message, or that taking the stairs was good exercise, a health information message. When the sign focused on social norms, the number of individuals who used the elevator versus the stairs dropped by 46% and persisted even a week after the sign had been removed. In contrast, there was no significant change in elevator use when the sign encouraged exercise (Burger & Shelton, 2011).

In the present study, reporting a measure of healthful purchases by cafeteria patrons may help to further increase such purchases. The diners may be especially receptive to such specific, cafeteria-level data as the data are more relevant to them given that the data are based on their peer-group as opposed to larger statistics, such as the purchasing behavior in the average hospital cafeteria or cafeterias across the city (Altman, 2010). Moreover, information regarding the normative dietary behavior may be more effective than highlighting the health benefits of better dietary choices.

*H11: Providing “social norm” information in the form of data related to cafeteria patrons’ healthful purchases—particularly data suggesting a strong norm of purchasing healthful items—will increase the percentage of healthful items purchased in the cafeteria compared to when there is no such information.*

In line with Burger and Shelton’s (2011) research on the impact of social norm and health information messages on stair and elevator use, we put forth the following additional hypothesis.<sup>33</sup>

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<sup>33</sup> In a recent study involving a public goods game played on computers, researchers found that while the effects of financial sanctions were stronger than those from social sanctions, once the sanctions were lifted, the effects of the social sanctions lingered longer, serving to increase fair play while those who had been under financial sanctions reverted to a more selfish form of play. The authors suggest that social norms may be more effective than fines at guiding behavior given that the norms tend to stay in place longer even after threat of punishment is removed (Nelissen & Mulder, 2013). We did not pit our social norm intervention against our economic interventions given

*H12: Providing “social norm” information will be more effective in increasing the percentage of healthful items purchased in the cafeteria than will be providing a health message (H4, H5, H6) about the benefits of the healthful option.*

## **Affective Intervention**

Although people often are unaware of the influence that their emotions have on their decisions (Johnson & Tversky, 1983; Lerner, Goldberg, & Tetlock, 1998), research demonstrates the extent to which it does (Forgas, 1995; Isen, 1993; Nygren, Isen, Taylor, & Dulin, 1996; Pfister & Böhm, 2008; Rusting, 1998; Schwarz & Bless, 1991; Slovic, Peters, Finucane, & MacGregor, 2005). Even emotions that are evoked in one setting can “spillover” and impact later situations without one’s awareness, which suggests that a stressful morning meeting can impact dietary choices at lunchtime beyond what one might imagine (Lerner, Small, & Loewenstein, 2004).

Yet, the relationship between affective states and dietary decisions, as distinguished from decisions in other domains, may be even more complicated. Emotional states have been shown to affect food preferences behaviorally (Englich & Soder, 2009; Zajonc & Markus, 1982), but neuroscience has revealed that the neurotransmitter dopamine, which directly impacts mood, also appears to affect the desire to consume food (Volkow et al., 2002). Additional evidence suggests that food cravings may come about at times from an emotional response associated with reward-related behavior (Berridge & Robinson, 1998; Higgs, 2006).

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that the economic interventions, once in place, remained in place for the duration of the study and we were not able to test the impact of changing the price back to pre-study levels. Additionally, we could not separate our social norm intervention from our economic ones, given that later interventions were layered on top of the economic (and colored-nutrition labeling) interventions. However, we note this study here as further evidence in support of other psychologically based interventions outside the typical economic or cognitive (more information) changes employed by the government to encourage more healthful eating.

Furthermore, food, specifically, has a physiological impact on mood; eating certain foods actually does impact and improve one's mood (Just & Payne, 2009; Wise, 2004). Consumption of palatable foods and even exposure to certain dietary cues can increase dopamine levels in the brain, thus improving mood (Bassareo & Di Chiara, 1999; Hernandez & Hoebel, 1988).

Beyond this reciprocal relationship and possibly owing to affect and hunger both being visceral in nature, the regulation of affect often impairs impulse and self-control, including that which is needed around food behaviors. Consequently, when people are emotionally distressed, they may prioritize behaviors and decisions that improve their affect rather than those that maintain their long-term goals including health (Tice, Bratslavsky, & Baumeister, 2001).

Given the complex, physiological interplay that occurs between affective state and dietary behavior, it makes sense to consider using affect to influence food purchases. Previous research related to affect and decision making typically focuses on the impact of an experimental mood induction on people's judgments and decisions. For instance, a recent cafeteria study looked at the impact of affect-inducing background photographs on food selection (McCormick & McElroy, 2009).

Lab studies on priming have shown that preference ratings for an object can be influenced by a prior unconscious (e.g., 10 ms) viewing of an affective stimuli, such as a smiling or angry human face (Murphy & Zajonc, 1993; Winkielman, Zajonc, & Schwarz, 1997). One lab study found that unconsciously viewing a "happy face" led people to pour and drink more of a beverage and subsequently rate it higher than those who viewed an "angry face" (Berridge & Winkielman, 2003; Winkielman, Berridge, & Wilbarger, 2005). While the faces in the lab studies were human faces presented unconsciously, research indicates that schematic smiley and frowny face drawings can evoke the same affective reactions as human faces (Britton, Shin,



Barrett, Rauch, & Wright, 2008; Eger, Jedynak, Iwaki, & Skrandies, 2003; Wright, Martis, Shin, Fischer, & Rauch, 2002). We know of no research to date that has actually attempted to pair specific food items in a real-world setting with a consciously presented affective stimuli, such that a specific food item is connected with positive or negative affect.

Thus, we propose that placing schematic smiley or frowny faces on food items can impact purchases. Healthy items with smiley face stickers are predicted to have higher sales than unhealthy items with frowny face stickers. We refer to the healthy smiley and unhealthy frowny face stickers collectively as emoticons. Such an intervention may have (at least) three different, potentially additive, effects. First, the emoticon may serve as a form of mood induction, actually impacting the customer's mood at the point of purchase. Secondly, the emoticon may serve as an affective signal of the value of the food item, such that a smiley face on a sandwich may suggest that the sandwich itself will make someone happy or is a positive choice for the person. Finally, the emoticon may serve as an emotional priming mechanism, where the emoticon is paired with the food item at the point of decision and purchase and then is remembered during consumption and its effect reinforced. Regardless, any of these three effects would suggest that emoticons could impact the sales of food items.

*H13: Placing emoticons on food items will impact the purchasing of food items, such that smiley faces on healthy items will increase sales compared to green items without smiley faces and frowny faces on unhealthy items will decrease sales compared to red items without frowny faces.*

## **Methods**

### **Research Setting**

We conducted our field experiment at the Cincinnati Children's Hospital Medical Center (CCHMC). CCHMC is a nationally recognized pediatric hospital serving the health needs of infants, children, and adolescents. As one of the largest pediatric hospitals in the United States, CCHMC exists as both a not-for-profit hospital and major research center, focused on providing outstanding family-centered patient care, pioneering breakthrough treatments, and training health care professionals for the future. Like many organizations around the country, CCHMC has developed a wellness plan to support its employees in making healthy food choices and achieving (or maintaining) appropriate weights (Baicker, Cutler, & Song, 2010; Halpern, Madison, & Volpp, 2009; Hewitt Associates, 2008; Kaiser Family Foundation and Health Research and Educational Trust, 2011; Tu & Mayrell, 2010; Volk & Corlette, 2012). The current research is in line with such efforts.

The experiments were conducted in the employee cafeteria called the "Rainbow Cafeteria." This cafeteria is in the main research building (Location S) at CCHMC's main campus (Figure 1). It is primarily frequented by researchers in the building rather than by patients or their families.

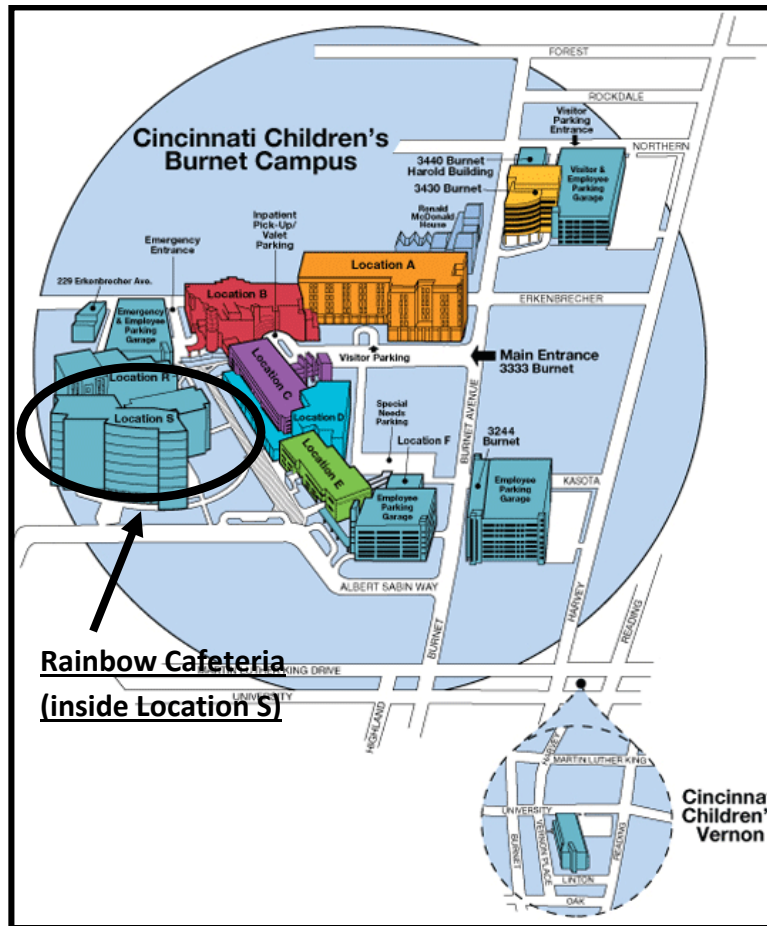


Figure 1: Cincinnati Children's Hospital Main Campus Map, indicating cafeteria location

It was beneficial to conduct our study at a worksite for several reasons. Worksites are promising venues for dietary interventions because most American adults spend large parts of most days at work, and workers are somewhat limited in their food choices (Lemon et al., 2009; Seymour, Yaroch, Serdula, Blanck, & Khan, 2004). In a national survey of employed Americans, one out of four said they usually purchased their lunch at a worksite cafeteria (Blanck et al., 2009). People also report that they consume more calories at work than at any other time aside from home or while traveling (Bertrand & Schanzenbach, 2009). Job demands have also been linked to increased consumption of sweets and snack foods while work fatigue and working overtime are associated with weight gain (Lallukka, Laaksonen, Martikainen,

Sarlio-Lähteenkorva, & Lahelma, 2005; Payne, Jones, & Harris, 2005). There is also evidence that high workload is associated with eating more food and work strain is associated with higher BMI (Kouvonen, Kivimäki, Cox, Cox, & Vahtera, 2005; Nishitani, Sakakibara, & Akiyama, 2009).<sup>34</sup>

In addition, assessing worksite cafeteria purchases allows different insight into food purchases than grocery store transactions or sit-down restaurants (Harnack & French, 2008). For example, with grocery store purchases, consumption is often separated in time from purchase (Just & Payne, 2009). Moreover, cafeteria diners do not tend to deliberate over the menu or selection of items in the same manner as patrons of sit-down restaurants. And diners may consider different factors when eating in an employee cafeteria and a restaurant, where the latter may be viewed as a setting in which to splurge (Harnack & French, 2008). These distinctions appear noteworthy. Furthermore, decisions during lunchtime and mid-day have a unique feature in occurring in the middle of the workday (for these particular 9-5pm employees), allowing a true assessment of food decision making in the midst of daily activities, where earlier tasks in the day, upcoming work-related meetings, and post-work events may be in the back of one's mind. In addition, these workers typically have 30-60 minutes for their lunch break, which might be considered a limited amount of time to walk to and from the cafeteria, make choices in different domains from main dish to side dish to drink consumption, and eat the meal. In such cases, patrons may be especially susceptible to heuristic thinking and consequently cues which aid decision making.

Moreover, it is important for hospital cafeterias to serve healthful options and be a model of good dietary habits, because visitors to hospitals believe that the food served there is more

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<sup>34</sup> Some evidence even suggests that, among men, high work stress increases BMI more so for those with an initially higher BMI than for those with an initially lower BMI (Kivimäki et al., 2006).

likely to be healthy (Sahud, Binns, Meadow, & Tanz, 2006). As an institution of healing, a hospital is a relevant place to test these interventions (Kolasa, Dial, Gaskins, & Currie, 2010). Recent research has called specifically for improvement to food outlets in children's hospitals, citing the need for signage promoting healthful options, the display of more nutritional information, and the removal of sugar-sweetened beverages (Lesser et al., 2012).

The Rainbow Cafeteria is open M-F from 7:30am-4pm and processes roughly 1,200 transactions amounting to \$3,900 in revenue daily, suggesting that an average transaction is \$3.25. There are vending machines that sell snack items and beverages in the building. The main cafeteria on campus is in another building a short (3-5 minute) walk (approximately 200 feet) from the Rainbow Cafeteria and is open 24-hours a day, Monday through Sunday, handling roughly 5,000 transactions each weekday and \$106,000 in revenue per week. The nearest outside food vendors are two chain sandwich shops which are approximately .3 miles and .5 miles from the research building.

## **Research Design**

Recent papers have examined healthful eating choices using hospital cafeterias. However, each of those studies looked at only two mechanisms, with the most recent study in this domain exploring five interventions (Jue et al., 2012). In the current research, we conducted nine separate experimental interventions in blocks of time called "phases." The phases examined the impact of six psychological mechanisms related to behavioral decision theory. Following the design of several other studies including Block et al.'s (2010) study in the cafeteria at Boston's Brigham and Women's Hospital and that of Jue et al. (2012) in several hospital cafeterias, we incorporated a "washout" phase between each distinct intervention phase, beginning with the emoticon phase. The "washout" phase returned the cafeteria to the baseline condition—which

we define as phase 3—which included the phase 1 soda price increase, phase 2 colored-nutrition labeling, and phase 3 water price decrease. These three conditions remained in place during subsequent phases and served as our basis of comparison, or baseline condition. Our washout periods were mostly three weeks in length (one was four weeks); the washout periods for Block et al. (2010) and Jue et al. (2012) were four weeks and one to two weeks, respectively. This recourse, returning the cafeteria to phase 3 conditions before and after all the interventions, afforded us several advantages.

First, although we intended to use phase 3 itself as the basis of comparison for each intervention phase, seasonality effects—that is, cafeteria purchasing behavior that varies primarily due to the changing of the seasons—may preclude us from using this initial phase 3 condition as the main baseline of comparison for each intervention phase. Consequently, having a baseline period immediately before and after an intervention phase enables a reduction and potential elimination of seasonality concerns.

Second, returning to the baseline condition before and after an intervention phase serves as an attempt to remove (or washout) the effects of a particular intervention after the completion of its testing phase. This washout is important to minimize the impact and potential carryover of an intervention on subsequent interventions, which could affect the accuracy and validity of the evaluation of the subsequent intervention period.

Before we detail our interventions, it is worth reiterating how our work differs from prior research, which we briefly mentioned earlier. Below we summarize in Table 1 past research alongside the current research.

Table 1: *Recent Behavioral Research on Consumer Food Choice in Hospital Cafeterias*

Author	Food Item	Intervention- Intended Effect (Significant- Sig. or Not Significant- NS)
Block et al. (2010)	<ul style="list-style-type: none"> <li>• Soda</li> </ul>	<ul style="list-style-type: none"> <li>• Price Increase (45 cents, 35%) on Regular Soda:: Sig.</li> <li>• Education Message (<i>Lose up to 15-25 pounds in one year and decrease your risk of diabetes by 1/2. Just skip one regular soda per day. For zero calories, try diet soda or water.</i>): NS</li> <li>• Price Increase (as above) &amp; Education (as above):: Sig.</li> </ul>
Webb, Solomon, Sanders, Akiyama, and Crawford (2011)	<ul style="list-style-type: none"> <li>• Entrees</li> <li>• Side Items</li> <li>• Snacks</li> <li>• Beverages</li> </ul>	<ul style="list-style-type: none"> <li>• Calorie Counts on Menu Boards and Posters:: <ul style="list-style-type: none"> <li>◦ Side Items and Snacks:: Sig.</li> <li>◦ Entrees:: NS</li> <li>◦ Beverages:: Not Analyzed</li> </ul> </li> </ul>
Schwartz et al. (2012)	<ul style="list-style-type: none"> <li>• Side Item (Chinese Food Vendor)</li> </ul>	<ul style="list-style-type: none"> <li>• Portion Control for Side Items:: Sig.</li> <li>• Portion Control for Side Items &amp; Price Decrease:: Sig.</li> </ul>
Thorndike et al. (2012)	<ul style="list-style-type: none"> <li>• Beverages</li> <li>• Certain Foods</li> </ul>	<ul style="list-style-type: none"> <li>• Colored-Nutrition Labeling (CNL):: Sig. for Certain Items</li> <li>• CNL &amp; Choice Architecture (Repositioning Items, Eye-Level, etc.): Sig. for Certain Items, Esp. Water</li> </ul>
Jue et al. (2012)	<ul style="list-style-type: none"> <li>• Soda</li> </ul>	<ul style="list-style-type: none"> <li>• Price Decrease (13 cents, 10%) on All Zero-Calorie Beverages:: NS</li> <li>• Price Decrease (as above) &amp; Discount Message (<i>Lighten up for less—10% off all zero-calorie bottled beverages and water</i>): Sig.</li> <li>• Calorie Message (<i>How many calories does that sugar-sweetened soda or tea contain? 260 Switch to zero-calorie beverages!</i>): Sig.</li> <li>• Exercise Message (<i>How long will it take on a treadmill to work off that sugar-sweetened soda or tea? 50 minutes Switch to zero-calorie beverages!</i>): NS</li> <li>• Calorie Message &amp; Exercise Message (<i>Typical sugar-sweetened beverages contain 260 calories and take 50 minutes to burn off on a treadmill. Why wait? Start drinking Zero-Calorie Beverages!</i>): NS</li> </ul>
Mazza (2013)	<ul style="list-style-type: none"> <li>• Beverage</li> <li>• Chips</li> <li>• Fruit</li> </ul>	<ul style="list-style-type: none"> <li>• Price Increase (25 cents, 16.6%) on Regular Soda</li> <li>• Colored-Nutrition Labeling (CNL)</li> <li>• Price Decrease (25 cents, 16.6%) on Water</li> <li>• Emoticons (Smiley/Frowny Faces)</li> <li>• Health Message (Calorie Message: % of daily calories in regular soda and regular chips)</li> <li>• Health Message (Exercise Message: Minutes of walking required to burn off regular soda and regular chips)</li> <li>• Social Norm Message (Fraction of cafeteria patrons choosing healthy beverages and healthy chips)</li> <li>• Healthy Substitute Pairing (Pairing a less healthful item with a healthful alternative)</li> <li>• Grouping by Healthfulness (Grouping items into categories by Colored-Nutrition Labeling)</li> </ul>

After collecting 12 months of cafeteria receipt data (M-F) prior to the start of our study, we conducted 9 sequential phases of interventions, with intervening “washout” phases between

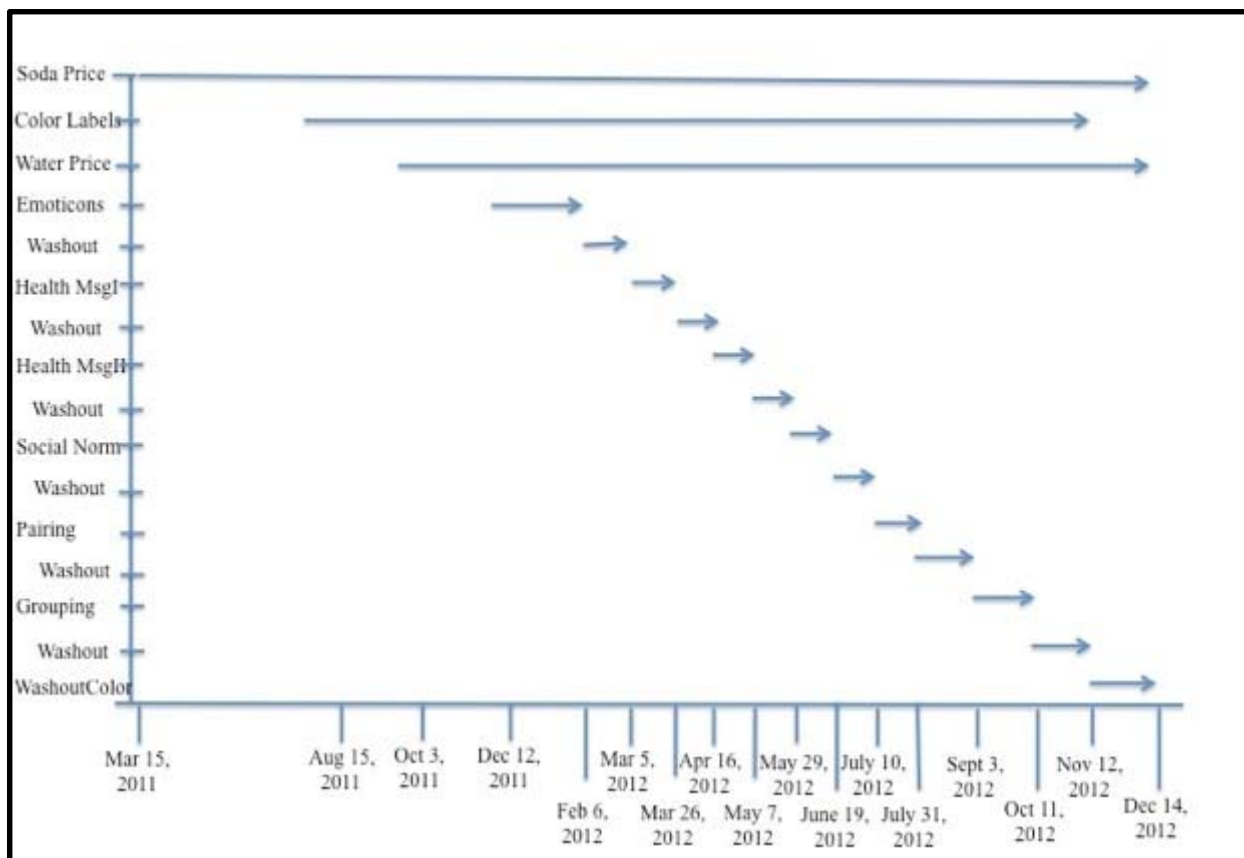
each phase after the emoticon phase (phase 4), as previously discussed, and a final phase, which removed the colored-nutrition labels while maintaining the price changes. All phases occurred sequentially and varied in length, although most phases lasted 3 weeks or 15 weekdays. Table 2 below briefly summarizes the phases and a description of their corresponding interventions.

Table 2: *Phases and Intervention Descriptions*

Phase	Intervention	Intervention Description
1	Soda Price	Price increase (25 cents) on regular soda
2	Color Labels	Retain price increase (25 cents) on regular soda. Add colored-nutrition labeling. Food items marked with a green, yellow, or red sticker.
3	Water Price	Retain price increase (25 cents) on regular soda and colored-nutrition labeling. Add price decrease (25 cents) on bottled water.
4	Emoticon	Retain price increase (25 cents) on regular soda, colored-nutrition labeling, and price decrease (25 cents) on bottled water. Add affective cues, emoticons, in the form of smiley and frowny faces.
5	Washout	A washout phase, returning the cafeteria to phase 3 conditions.
6	Health Message I	Retains phase 3 conditions. Add a health message (% daily calories for beverages, exercise for chips).
7	Washout	A washout phase, returning the cafeteria to phase 3 conditions.
8	Health Message II	Retains phase 3 conditions. Add a health message (exercise for beverages, % daily calories for chips).
9	Washout	A washout phase, returning the cafeteria to phase 3 conditions.
10	Social Norm	Retain phase 3 conditions. Add a social norm message (Fraction of cafeteria patrons choosing healthy beverages and healthy chips).
11	Washout	A washout phase, returning the cafeteria to phase 3 conditions.
12	Healthy Substitute Pairing	Retain phase 3 conditions. Add a healthy substitute pairing (Pairing a less healthful item with a healthful alternative).
13	Washout	A washout phase, returning the cafeteria to phase 3 conditions.
14	Grouping	Retain phase 3 conditions. Add grouping (Grouping items into categories—green, yellow, red—by Colored-Nutrition Labeling).
15	Washout	A washout phase, returning the cafeteria to phase 3 conditions.
16	Remove Color Labels	Remove the colored-nutrition labels. Retain price changes (25-cent price increase on regular soda, 25-cent price decrease on bottled water).

Figure 2 presents a visual depiction of the experimental timeline.





*Figure 2: Timeline of 16-Phase Cafeteria Intervention, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, March 2011-December 2012*

Table A in the appendix displays similar information as Figure 2 along with additional details in table form, including the order of the phases, the psychological domains under review, the intervention tested, and the corresponding hypotheses. We will now provide a more descriptive outline of the study.

**Phase 1: Price increase on regular soda.** After collecting 12 months of historical data of cafeteria purchases, a price change intervention—an increase in the price of regular 20-ounce soft drinks—was put in place on Tuesday, March 15, 2011.<sup>35, 36</sup> The price of regular soft drinks,

<sup>35</sup> As we will discuss later in the limitations section of the paper, we were unable to use this historical data in our analysis due to the fact that the register coding did not allow us to differentiate between the various beverages

an item that would later be classified as a “red” and less healthful item, were increased by 25 cents in the cafeteria, making them more expensive than other items in the same category (beverages), specifically 20-ounce diet soft drinks and 20-ounce bottled water (excluding Evian and Mineral Water) which would later be labeled as “green.” It is worth noting that a similar price differential was put in place in the vending machines, the other cafeterias, and all other hospital dining outlets at the same time. If item pricing in the experimental cafeteria were to differ from that of the vending machines and other dining outlets, it potentially would have been problematic in terms of observing true changes in cafeteria purchasing behavior of the same (or even substitutable) beverage items. Patrons might have learned of a price differential and opted to buy from the lowest priced venue. In addition, given that the cafeterias charge tax and vending machines do not, the price increase in the cafeteria appeared as a 23-cent price increase from \$1.41 to \$1.64, which was effectively \$1.75 with tax in the cafeterias and vending machines. (Table 3).

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(regular soda, diet soda, and water) and chips in our study. Once phase 1 commenced, we were able to differentiate between regular sodas and diet sodas and water, with the latter two beverage categories remaining on the same register key until phase 3, when the price of water dropped. Similar, for chips, the different chip colored-nutrition label categories were not differentiable until phase 1.

<sup>36</sup> It is important to note that although the cafeteria sells some 12-ounce canned sodas, the majority of soft drinks (over 90%) that are stocked are 20-ounce bottled beverages. The price of 12-ounce canned regular sodas did not change and there was no way to distinguish between regular and diet canned sodas at the register. Consequently, they were excluded from data collection and analyses in this and all phases of the study.

Table 3: *Pricing of Water, Diet Soda, and Regular Soda Prior to and After March 15, 2011*

<b>Prior to March 15, 2011</b>		
	Cafeteria Price Tag	Cafeteria With Tax & Vending Machines
Water	\$1.41	\$1.50
Diet Soda	\$1.41	\$1.50
Regular Soda	\$1.41	\$1.50
<b>March 15, 2011 Forward</b>		
	Cafeteria Price Tag	Cafeteria With Tax & Vending Machines
Water	\$1.41	\$1.50
Diet Soda	\$1.41	\$1.50
Regular Soda	<b>\$1.64</b>	<b>\$1.75</b>

**Phase 2: Colored-nutrition labeling (and price increase on regular soda).** For the second phase, members of the research team created a color-coded food nutrition labeling system, whereby food items were classified as green, yellow, or red based on a given food item's total calories, amount and quality of fat, amount of sugar and sodium, and the food's glycemic index (Table 4).<sup>37</sup> The labeling was in line with the hospital's existing, healthy eating plan (HEP), for overweight patients. The system was advertised as a "traffic light"—green-yellow-red—eating guide to assist in making food choices, not a diet per se.

Foods in the green category are considered the foundation for a healthy diet and to be eaten "frequently." Specific food items include fruits and vegetables, whole grain items, lean meats, and low-fat cheeses. These foods do not contain trans fats.

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<sup>37</sup> The glycemic index indicates the effects of foods, specifically the carbohydrates in foods, on blood glucose (sugar) levels. Rapidly digested foods that raise blood sugar quickly are considered to be high on the glycemic index; those that release sugar more slowly are considered lower on the glycemic index (Jenkins et al., 2002; Jenkins et al., 1981).

Yellow category foods are only to be eaten “sometimes” as they are higher in saturated fat, calories, sugar and/or sodium levels than green foods. But, like green foods, yellow category foods do not contain any trans fats.

Red category foods are to be eaten “rarely” as they are either very high in calories, sugar, fat, sodium and/or contain trans fats.

Table 4: *Nutritional Guidelines for Green-Yellow-Red Labeling*

	<b>Green</b>	<b>Yellow</b>	<b>Red</b>
<i>Calories</i>	<550	550-650	>650
<i>Fat</i>	<5%	5-45%	>45%
<i>Cholesterol</i>	<100mg	100-150mg	>150mg
<i>Sodium</i>	<800mg	800-1,000mg	>1,000mg
<i>Saturated Fat</i>	<10%	10-15%	>15%
<i>Trans Fat</i>	0g	0g	<1g
<i>Sugar</i>	<12g	12-15g	>15g

Five months after phase 1, on Monday, August 15, 2011, green and yellow items were labeled with red labels being added the following day. A sticker was placed on the labels in front of pre-packaged items and beverages and next to items on the menu board in the cafeteria and the online cafeteria menu. (Figures 3-5).



Figure 3: Soda Display Case with Colored Labels



Figure 4: Salad Menu Displayed by Salad Station Inside Rainbow Cafe



*Figure 5: Chip Menu with Colored Labels near the Chip Display*

The same nutritional information related to the colored labels was posted in prominent locations around the cafeteria on posters and flyers and on the cafeteria website. With regards to the posters, a giant poster displaying the image of a traffic light, near a real traffic light on the wall, was placed near the entrance of the cafeteria and another on a wall inside the cafeteria to explain the color-coding system. (Figures 6-8). The sign noted that green means eat “Frequently,” yellow means eat “Sometimes,” and red means eat “Rarely.” The phrase “Remember, portion size matters” was included below the colors. The same information was printed on a 5 x 7 inch cardstock flyer for customers to take with them. (Figures 8-9).



*Figure 6: Traffic Light and Menu Board Outside Entrance of Rainbow*



*Figure 7: Signage Outside Entrance of Rainbow Café*

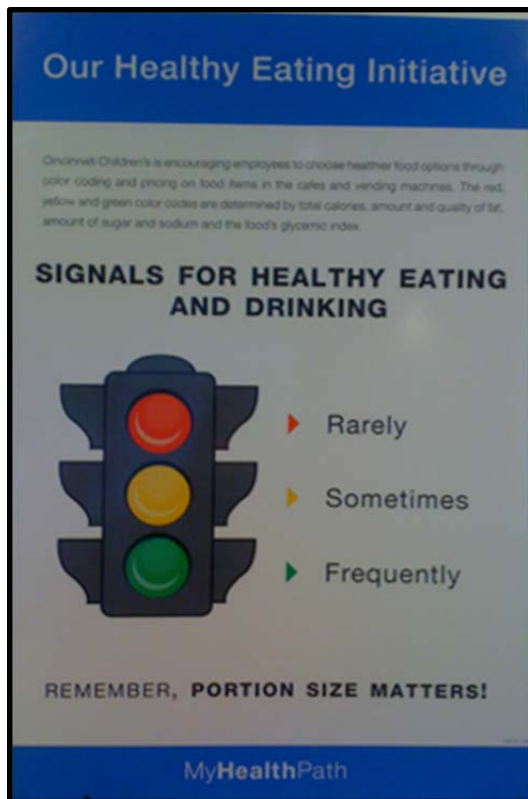


Figure 8: Poster Outside Rainbow Café and Flyer Handed to Customers



Figure 9: Backside of Customer Flyer



In addition, information appeared on CenterLink, the hospital's internal website that conveys a variety of information, including the weekly cafeteria menu (Figure 10). It also appeared under the "MyHealthPath" section of CenterLink, which offers employees targeted individual guidance in how to maintain a healthy lifestyle and set goals for making improvements. (Figures 11-12). Prior research suggests employer online communication about health information is more effective than posters, though we did not offer any specific hypotheses regarding these modes of communication (Hewitt Associates, 2008). We utilized online outreach purely as a means for conveying the new colored-nutrition labeling system.





CenterLink


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Total Rewards

MyHealthPath | Healthy Eating

### Healthy Eating Initiative

Healthy eating is about knowledge and balance. In our cafes and vending machines we are working to provide healthier options, to be more transparent about nutritional content in our food offerings, and to provide incentives for you to make healthier food choices. Our efforts so far have included:

- Discounts on the healthy food entree
- Introduction of the jazz salad bar
- Green/Yellow/Red labeling on food items (*details below*)
- Replacing all wheat bread with healthier multi grain bread
- Nutrition labels on entrees and 'Simply To Go' sandwiches and salads
- Expanded nutrition information posted on signage
- "Did You Know" facts posted in our cafes
- The "knowledge TV" at the entry of the main hospital cafe
- Healthier drink options, like water and diet soda, placed at eye level in vending machines.
- Healthier options are generally priced lower than unhealthier items of the same size and quantity.



### The G-Y-R Eating Guide

Have you seen the Green, Yellow, and Red labels on food items in the cafes? The labels are there to help you choose healthier meals and snacks. Ratings are determined by total calories, amount and quality of fat, amount of sugar and sodium, and the food's glycemic index. Foods with a low glycemic index tend to be healthier choices because they have less sugar, more fiber, and induce less rebound hunger. The table below shows the nutrient standard we use to determine the status of food items.

#### Green

Green category foods can be eaten frequently and are the basis for a healthy diet. Foods in this group include fruits and vegetables, lean meats, whole grain products and low fat cheeses. Specific criteria include:

- Less Than 550 calories
- Less Than 35% fat
- Less Than 100 mg Cholesterol
- Less Than 800 mg Sodium
- Less Than 10% Saturated Fat
- Zero Trans fat
- Less Than 12 g Sugar

#### Yellow

Yellow category foods should be eaten sparingly. They are higher in saturated fat, calories, sugar and/ or sodium content than green category foods. Specific criteria include:

- 550 to 650 calories
- 35% to 45% fat
- 100 mg to 150 mg Cholesterol
- 800 mg to 1,000 mg Sodium
- 10% to 15% Saturated Fat
- Zero Trans fat
- 12 g to 15 g Sugar

#### Red

Red category foods are either very high in calories, sugar, fat, sodium and/ or contain trans fats. These foods should be eaten rarely. Specific criteria include:

- More than 650 calories
- More than 45% fat
- More than 150 mg Cholesterol
- More than 1,000 mg Sodium
- More than 15% Saturated Fat
- Less than 1 g Trans fat
- More than 15 g Sugar

Figure 11: Description of Color Labeling on CCHMC's Internal "MyHealthPath" Website

May 11, 2011

## Details about our Healthy Eating Initiative

*What's the nutritional information behind the red, yellow, and green color codes?*

Like most of the nation, Cincinnati is battling an increase in obesity and weight-related health conditions.

CCHMC is encouraging employees to choose healthier food options through color coding and pricing on food items in the cafes and vending machines. Providing better information and signals supports our health-driven mission and translates into benefits for employees, including potentially improved health, and reduced insurance costs.

The red, yellow, and green color codes are determined by total calories, amount and quality of fat, amount of sugar and sodium, and the food's glycemic index. Foods with a low glycemic index tend to be healthier choices because they have less sugar, more fiber, and induce less rebound hunger.

Green category foods can be eaten frequently and are the basis for a healthy diet. Foods in this group include fruits and vegetables, lean meats, whole grain products and low fat cheeses. Specific criteria include:

- Less Than 550 calories
- Less Than 35% fat
- Less Than 100 mg Cholesterol
- Less Than 800 mg Sodium
- Less Than 10% Saturated Fat
- Zero Trans fat
- Less Than 12 g Sugar



Yellow category foods should be eaten sparingly. They are higher in saturated fat, calories, sugar and/ or sodium content than green category foods. Specific criteria include:

- 550 to 650 calories
- 35% to 45% fat
- 100 mg to 150 mg Cholesterol
- 800 mg to 1,000 mg Sodium
- 10% to 15% Saturated Fat
- Zero Trans fat
- 12 g to 15 g Sugar



Red category foods are very high in calories, sugar, fat, sodium and/or contain trans fats. These foods should be eaten rarely. Specific criteria include:

- More than 650 calories
- More than 45% fat
- More than 150 mg Cholesterol
- More than 1,000 mg Sodium
- More than 15% Saturated Fat
- Less than 1 g Trans fat
- More than 15 g Sugar



Figure 12: Description of Color Labeling on CCHMC's Internal "MyHealthPath" Website

We noted several problems within the first few weeks of this phase related to implementation and customer reaction. First, with regards to the actual implementation, there were several items that could not be labeled or that we noted were labeled incorrectly. Items that change daily (entrees and side dishes made by staff) on a five-week rotation were not able to be labeled feasibly. Grapes were originally labeled “yellow” rather than “green” like the rest of the fruit. Some of the non-soda beverages in one of the display cases near the entrance (with Tropicana, V8, various energy drinks, etc) were mislabeled. Flavored Greek yogurt was labeled “green” like plain Greek yogurt, however its sugar content makes it a “yellow” item. Individual packets of salad dressing (roughly eight types of regular dressing and five of light or fat free dressing) were not placed in the correct color slots by cafeteria staff. About three weeks after the start of the phase, one of the researchers and the cafeteria manager walked through the cafeteria to discuss these problems and make changes.

In relation to customers, we learned at least two things early on in this phase. First, it appeared customers desired more information about the color-nutrition labeling. Although we had a poster at the cafeteria entrance and one on the wall, 5 x 7 inch information cards, and details about the initiative on the hospital’s internal employee website (CenterLink) and health page (MyHealthPath), customers still seemed unsure why certain items were labeled a particular color. With regards to the latter, the second main takeaway concerned how passionate people felt about the labels, taking the time to email management or discuss their thoughts and feelings with cafeteria staff. For instance, there was confusion regarding Diet Red Bull being labeled “green”; it was decided that the label for Diet Red Bull should be removed and it would not be labeled. Regular Red Bull continued to have a “red” label. Some people were not pleased that

diet soda was labeled “green”; the research team discussed changing it to “yellow” but kept the green labels.

In addition, there is a separate kiosk in the cafeteria which sells Starbucks coffee, pastries, and cold bottled beverages in a low display case. The bottled beverages on display are far fewer (roughly two of a particular type) than in the display cases inside the main area of the cafeteria. However, because these beverages do not have set positions in the cases, we were unable to label them. Many of the items that are bought at the kiosk are paid for at the kiosk registers. However, it is possible for a patron to pick up a bottled beverage from that section and pay for it using the registers in the main part of the cafeteria, or conversely, a customer could select a bottled beverage in the cafeteria and pay for it at the kiosk register. We are not able to control for purchased items that might have originated in the kiosk or cafeteria items that were purchased at the kiosk (though the latter is less likely). We are not particularly concerned about this as only a small number of purchases are likely to fall into these categories.

**Phase 3: Price decrease on bottled water (and colored-nutrition labeling and price increase on regular soda).** Approximately six weeks after the start of phase 2, on Monday, October 3, 2011, the price of a healthy, green item, bottled water, decreased by 25 cents, making it less expensive than yellow and red items in the same food category (e.g., beverages).<sup>38</sup> Again, similar to the price increase on regular soda, the price tag in the cafeteria reflected a 24-cent price drop from \$1.41 to \$1.17, which was effectively \$1.25 with tax in the cafeterias and vending machines (Table 5).

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<sup>38</sup> Bottled water includes 20-ounce Dasani bottled water and other 20-ounce regular bottled waters, but not Dasani 1 liter bottles, Evian, Mineral Water, or Vitamin Water, the latter of which is first introduced to the cafeteria on November 17, 2011.

Table 5: *Pricing of Water, Diet Soda, and Regular Soda Prior to and After October 3, 2011*

<b>Prior to March 15, 2011</b>		
	Cafeteria Price Tag	Cafeteria With Tax & Vending Machines
Water	\$1.41	\$1.50
Diet Soda	\$1.41	\$1.50
Regular Soda	\$1.41	\$1.50
<b>March 15-October 2, 2011</b>		
	Cafeteria Price Tag	Cafeteria With Tax & Vending Machines
Water	\$1.41	\$1.50
Diet Soda	\$1.41	\$1.50
Regular Soda	<b>\$1.64</b>	<b>\$1.75</b>
<b>October 3, 2011 Forward</b>		
	Cafeteria Price Tag	Cafeteria With Tax & Vending Machines
Water	<b>\$1.17</b>	<b>\$1.25</b>
Diet Soda	\$1.41	\$1.50
Regular Soda	<b>\$1.64</b>	<b>\$1.75</b>

Both water and diet soft drinks continued to be labeled green, although water was now at a lower price point. This provides an interesting comparison of the effects of labeling and price, as both sets of beverages are labeled the same color but one is priced less. The pricing also reflects the fact that we would prefer to encourage water consumption over diet soda consumption, but would promote either of the two over regular soft drinks, which were priced highest of all.

During this phase, on Tuesday, November 1, 2011, several hospital system-wide food price changes went into effect that increased prices on some items by 2-26 cents. These price

changes were not part of our study and we had no control over the timing of these changes.<sup>39</sup>

Roughly 20 items in the experimental cafeteria were affected (Table 6) but the main items of interest, bottled beverages and chips, were not impacted by these price changes.<sup>40</sup> Furthermore, we analyzed the data treating November 1-November 29 as a distinct phase and found no impact on the healthfulness of beverage and chip sales due to the price changes of these others items.

Table 6: *Price Changes Effective November 3, 2011 to Food Items Not Related to Our Study*

Item	Prior Price	New Price
Hot Tea	0.39	0.49
Danish	0.99	1.19
Donuts	0.79	0.99
Boiled Egg	0.49	0.59
Bacon	0.29	0.34
Sausage Link	0.29	0.34
Shredded Cheese	0.29	0.31
Bagel & Cream Cheese	0.94	1.19
Bagel	0.69	0.89
Coffee Cake	1.09	1.29
Hot Cereal 12oz	0.79	0.89
Soup 8oz	1.49	1.69
Soup 12oz	1.69	1.89
Soup 16oz	1.89	2.09
Entrée	2.79	2.99
Fresca Sandwich	3.29	3.49
Fresca Salad	3.88	4.08
Wrap Sandwich	4.09	4.29
Bag Candy	2.19	2.39
Bag Nuts	3.49	3.69
Cookies	1.19	1.29

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<sup>39</sup> In addition, as the prices were changed, some of the signage with the old prices and colored labels were removed on November 3, such that some signage no longer had colored labels. These were not items of interest to our data analysis but worth noting.

<sup>40</sup> We note that fruit, which might be a substitute for chips, was listed as changing in price during this time, from 65 cents to 69 cents, before tax. However, from the register receipts, the fruit price change did not appear to be effective until January 11, 2012. However, fruit transactions over the course of the study averaged 33 (32.52) pieces of fruit per day and 8 (7.63) fruit cups per day. Again, this discussion of fruit excludes fruit purchased as part of a meal combo, which as we discuss, was recorded by the registers as a “chip/fruit” purchase, preventing us from determining if fruit or chips were purchased.



In addition, on Wednesday, November 30, 2011, the round color-labels were replaced with larger, more durable, laminated colored labels that were squares, 1 x 1 inch in size (Figure 13). No impact was expected from the labels being slightly larger, laminated, or squares rather than circles. We did analyze the data treating November 30-December 11 as a distinct phase and found no impact of the new color labels. Therefore, given that there appeared to be no distinct effect of the hospital-wide food price changes that went into effect on November 1, 2011, or the laminated square colored labels that were put in place on November 30, 2011, we treated October 3-December 11 as one phase.



*Figure 13: Soda Display Case with Larger, Square Colored Labels*

**Phase 4: Emoticons (and price changes and colored-nutrition labeling).** On Monday, December 12, 2011, 10 weeks after the start of phase 3, an emoticon intervention was added to the colored-nutrition labels. The green stickers in front of green items were replaced with green stickers with smiley faces while the red stickers in front of red items were replaced with red stickers with frowny faces. The labels for yellow items remained the same as before, without a face. (Figures 14-17).



*Figure 14: Soda Display Case with Emoticon Labels*



Figure 15: Close Up View of Soda Display Case with Emoticon Labels



Figure 16: Chip Menu with Emoticon Labels near the Chip Display



*Figure 17: Chip Display with Emoticon Labels*

**Phase 5: Washout – only price changes and colored-nutrition labeling.** After the emoticon labels had been in place for eight weeks, on Monday, February 6, 2012, they were removed, and the green smiley face stickers were replaced with the previous green stickers and the red frowny face stickers were replaced with the earlier red stickers. This first washout period effectively returned the cafeteria to phase 3 conditions. Data continued to be collected; this washout lasted four weeks, through Friday, March 2, 2012. This washout period was one week longer than later washout periods due the fact that the previous phase, the emoticons, lasted longer than subsequent intervention phases, with the emoticons in place for eight weeks and later intervention phases in place for only three.

**Phase 6: Health message I (and price changes and colored-nutrition labeling).** After the four-week washout period, on Monday, March 5, 2012, the first of two health message phases began. We used two signs, one that targeted regular, red-labeled sodas and another that targeted red-labeled chips. We focused on these two categories of items for several reasons. Regular soft drinks are important to the political debate and involved in our price intervention, as well as in the traffic light colored-nutrition labeling and emoticon phases. Chips, while not a category traditionally thought of as healthful, are offered in a several varieties in the cafeteria, including in each of the three color categories. Importantly, both beverages and chips contained items in different color categories that we were able to identify by the register codings.

The health messages related to regular sodas and red-tagged chips and mentioned the percentage of daily calories the item contained or the amount of exercise needed to burn off the calories in the item. Although Bleich et al.'s (2011) study used an exercise message about running and Jue et al. (2012) mentioned time on a treadmill, we chose to focus on walking, which while a less effortful physical activity, requires more time to burn the calories than running requires. However, like Bleich et al. (2011) and Jue et al. (2012), our message also refers to the amount of time required in that activity, as opposed to distance or some other descriptive feature.<sup>41</sup>

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<sup>41</sup> In terms of an exercise message, there were several things to consider including the actual exercise activity to be used in the message (e.g., walking, vs. running vs. other things) and whether the message points to the time required to do an activity (e.g., minutes of walking) or perhaps the distance required (e.g., 2 miles of walking). The researchers felt that mentioning "time" makes time salient and people are familiar with the concept of an hour of time. Stating distance (e.g., 2.5 miles) was thought to make mileage the focus and perhaps effort a bit more salient—though in general mileage is probably less well understood than time by the general public. We felt that there was likely to be less ambiguity in hearing and understanding a time reference than a distance references. However, it is possible that increased ambiguity could be beneficial by perhaps sounding more arduous and more difficult to envision, and thus, distance could be a better descriptive reference than time for motivating people's dietary choices. We leave that to future research to explore.

A 20-ounce regular bottled soda has 250 calories; a bag of red chips sold in the cafeterias has on average 250 calories. For the calculation of percentage of daily calories, we took 2,000 calories as the recommended caloric intake for the average adult, a figure noted on many nutrition labels. Thus, the 250 calories for both the regular bottled soda and the bag of red chips represent 12.5% of the recommended daily calories.

For the exercise message, data from the CDC reports the average female in the United States weighs 166.2 lbs. and the average male weighs 195.5lbs. (Fryar, Gu, & Ogden, 2012). Based on a formula that estimates the calories burned per mile while walking at a rate of 3-4 miles per hour (mph) to be equivalent to weight multiplied by .53, the average female burns 88.09 calories per mile walked and the average male burns 103.62 calories (Burfoot, 2005). Therefore, to burn 250 calories at what is considered a “moderate” walking rate of 3mph, a woman must walk 2.84 miles and a man must walk 2.41 miles, which again at a rate of 3pmh, would take nearly 57 minutes (56.8) and just over 48 minutes (48.2) for women and men, respectively.<sup>42</sup> Given that male and female calorie burning rates differ, as the average male weighs more than the average female, we decided to discuss the amount of walking required to burn the calories as being “almost an hour of walking.”<sup>43</sup>

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<sup>42</sup> The formula we used estimated the calories burned per mile while walking at a rate of 3-4 mph. Calories burned is equivalent to weight multiplied by .53. The number of calories burned for these equations refer to the total number of calories burned, rather than the net number of calories, which measures the calories burned minus basal metabolism. To measure the net calories burned while walking, weight is multiplied by .3 rather than .53. This would change our estimation of calories burned per mile walked and walking time required for both men and women. Women would be expected to burn 49.86 calories per mile (rather than 88.09) and need to walk 5.01 miles, roughly an hour and 40 minutes of walking. Men would be expected to burn 58.65 calories per mile (rather than 103.62) and need to walk 4.26 miles, for a total walking time of one hour and 25 minute (Burfoot, 2005).

<sup>43</sup> It is worth noting the statements that Bleich et al. (2011) and Jue et al. (2012) used regarding their exercise message and that Bleich et al. (2011) used, for their percentage of daily calories message. With regards to Bleich et al. (2011), their messages were as follows: “Did you know that working off a bottle of soda or fruit juice takes about 50 minutes of running?” “Did you know that a bottle of soda or fruit juice has about 10% of your daily calories?” Their numbers are different partially because they were targeting adolescents, whose metabolisms are different than adults, and they were using a different activity—running—rather than walking. The exercise message used by Jue et

One sign, either the percentage of daily calories message or the exercise message, for both the regular bottled soda and the bag of red-tagged chips was used in each of the two phases; to counterbalance the messaging used, the first phase involved the message of percentage of daily calories for regular soda and the exercise required to burn off a bag of red-tagged chips. The second phase used the exercise message for regular soda and the percentage of daily calories message for a bag of red-tagged chips. The signs were placed in the cafeteria, one near the soda cases and one by the chip rack. The exact wording of the signs for the first of the two health message phase is noted below. The two signs were on 8.5 inch x 11 inch laminated paper (Figure 18).

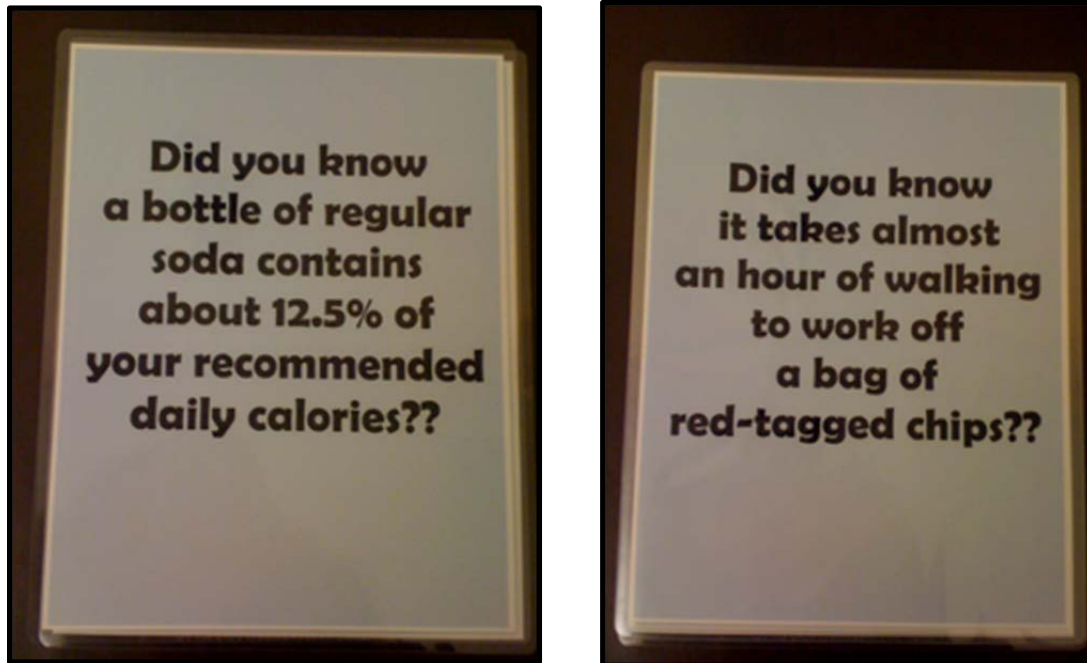
(Percentage of daily calories) Did you know a bottle of regular soda contains about 12.5% of your recommended daily calories??

(Exercise) Did you know it takes almost an hour of walking to work off a bag of red-tagged chips?

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al. (2012) was, “HOW LONG? How long will it take on a treadmill to work off that sugar-sweetened soda or tea? Minutes on a Treadmill 50:00. SWITCH TO ZERO-CALORIE BEVERAGES!” Jue et al. (2012) included a caloric message but not a message based on percentage of total daily intake of calories. Their caloric message read, “HOW MANY? How many calories does that sugar-sweetened soda or tea contain? Calorie Counter 260. SWITCH TO ZERO-CALORIE BEVERAGES!” In addition, these authors included a combined messaged which said, “WHY WAIT? Typical sugar-sweetened beverages contain 260 calories and take 50 minutes to burn off on a treadmill. Why wait? Start drinking Zero-Calorie Beverages! SWITCH TO ZERO-CALORIE BEVERAGES!”





*Figure 18: First Health Message Signs for Soda and Chips*

As we have noted, these signs are patterned after Bleich et al. (2011) in hopes of adding to that body of research that translates nutrition information into more novel metrics, like percentage of daily calorie intake and exercise. However, the messages are focused on the product we hope to discourage consumers from buying, regular soft drinks, rather than the product we hope to encourage purchasing, diet soft drinks, water, or some other non-calorie beverage. We did reflect on the costs and benefits of using negatively as opposed to positively framed messages. However, in a meta-analysis of 35 studies involving the framing effects on health consumers, although positively framed messages may have led to more positive perception of effectiveness than negatively-framed messages, there was little difference in persuasiveness and behavior (Akl et al., 2011).

The signs were in place for three weeks, until close of business on Friday, March 23.



**Phase 7: Washout – only price changes and colored-nutrition labeling.** On Monday, March 26, 2012, the two health message signs were removed, returning the cafeteria to phase 3 conditions. Data continued to be collected; this washout lasted three weeks, through Friday, April 13, 2012.

**Phase 8: Health message II (and price changes and colored-nutrition labeling).** On Monday, April 16, 2012, the second set of health message signs were put in place in the cafeteria. Whereas the first set referred to percentage of daily calories of regular soda and exercise related to red-tagged chips, this set involved exercise related to regular soda and the percentage of daily calories of red-tagged chips. The wording of these two signs is noted below. The two signs for this second health message phase (Figure 19) and the soda message on the soda display case (Figures 20-22) are shown below, the latter from several views so as to give perspective on the size of the sign compared with the soda case itself.

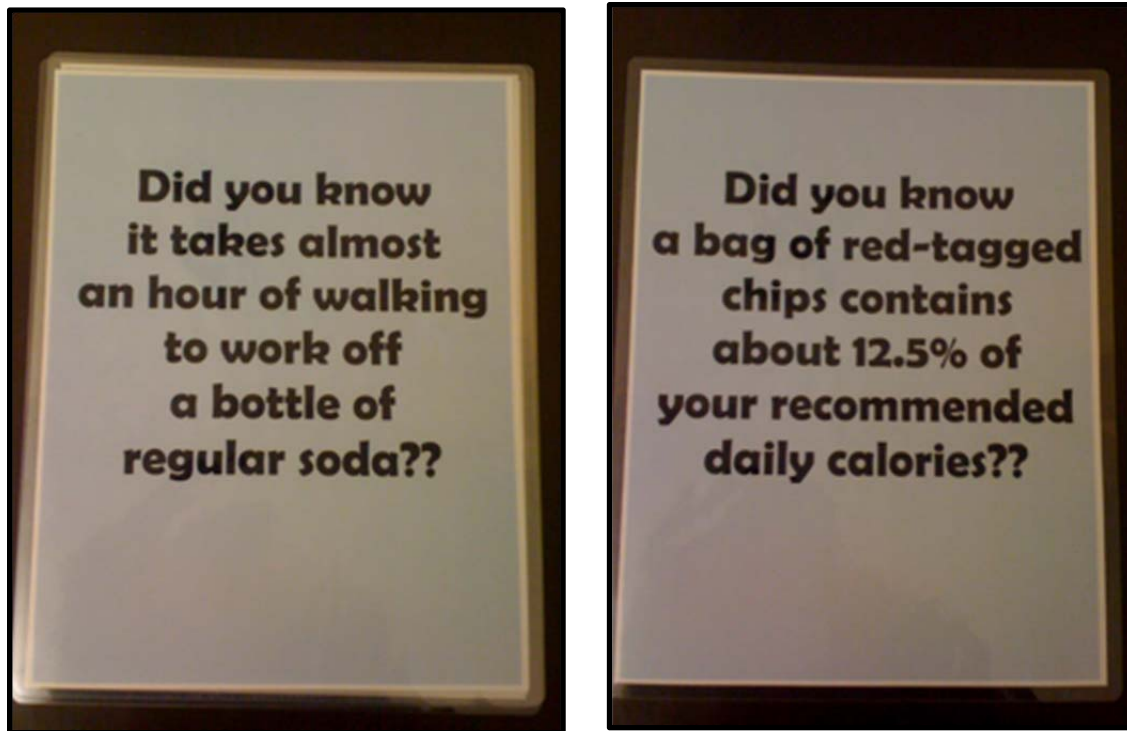
(Exercise) Did you know it takes almost an hour of walking to work off a bottle of regular soda?

(Percentage of daily calories) Did you know a bag of red-tagged chips contains about 12.5% of your recommended daily calories??

The signs were in place for three weeks, until close of business on Friday, May 4.<sup>44</sup>

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<sup>44</sup> We realized on Tuesday, April 17, that customers had pulled off some of the colored labels, behavior that presumably had occurred for several days, potentially since the prior Thursday, April 12. These labels only involved a few products, none of which were of primary interest to our study. However, such behavior may indicate customer frustration with the changes to the cafeteria and seems worth recognizing, even if we do not have any particular hypothesis about how that might impact our study results or such a study in the future.



*Figure 19: Second Health Message Signs for Soda and Chips*



*Figure 20: Second Health Message on Soda Display Case*



Figure 21: Second Health Message on Soda Display Case



Figure 22: Second Health Message on Soda Display Case

**Phase 9: Washout – only price changes and colored-nutrition labeling.** On Monday, May 7, 2012, the two health message signs were removed, returning the cafeteria to phase 3 conditions. Data continued to be collected; this washout lasted three weeks, through Friday, May 25, 2012.

**Phase 10: Social norm message (and price changes and colored-nutrition labeling).** Given that the cafeteria was closed for Memorial Day on Monday, May 28, 2012, the intervention on social norms began on Tuesday, May 29, 2012, for a period of three weeks. Like the health message phases, we again used messages targeting beverages and chips. The intervention occurred at this point in the study in hopes of capitalizing on the expected success of earlier interventions in increasing customer purchases of green items such that the reported healthful behavior of cafeteria patrons mentioned in the message would be greater than what otherwise might be expected if we were to implement the social influence intervention earlier in the study.

We anticipated using a social influence message based on recent work that compares a health message with a social influence message (Burger & Shelton, 2011). The social norm message in that study read, “Did you know? More than 90 percent of the time, people in this building use the stairs instead of the elevator. Why not you?” We decided to keep our message similar in format to the ones we used in the health message phases, using one interrogative sentence beginning with you “Did you know...” and omitting the hypothetical question Burger & Shelton (2011) pose at the end.

In creating a social norm message, we could either craft a message that focused on the unhealthful item purchases (red purchases) as we did for the health messages or on the healthful item purchases (green purchases). Social science research from other domains indicates that

using positive social messages about the desired behavior is more effective than using negative messages about the undesired behavior. For instance, to increase voter turnout, informing people of the high voter turnout increases intention to vote more than sharing information of low voter turnout statistics (Gerber & Rogers, 2009; Gerber & Yamada, 2009). Consequently, rather than pattern the social norm message after the health message which focused on discouraging the purchase of the unhealthful item for ease of comparison, we determined to create the most effective message we could. Thus, we focused on people's good behavior and purchases of healthful food and beverages.

In addition, when analyzing the data to determine actual beverage purchases and chip purchases, we found that over 75% of people buying bottled beverages chose diet soda or water rather than regular soda and that just over 66% of people buying chips purchased green or yellow-tagged chips rather than red-tagged chips. Given the chip sales in particular was not a nice round number (like 90% as in the aforementioned research or even the 75% in our beverage sales), we determined to use fractions for both social norm messages and express a number below the exact number in order to use the word "over" rather than "nearly." (For example, rather than saying "nearly 70%" to express good chip choices, we chose to say "over 2/3.") The wording of these two signs is noted below.

(Chips) Did you know that over 2/3 of people buying chips in the cafeteria choose green or yellow-tagged chips instead of red-tagged chips?

(Beverages) Did you know that over 3/4 of people buying bottled beverages in the cafeteria choose diet soda or water instead of regular soda?

These two signs were meant to resemble each other as closely as possible, with the fraction used necessarily differing due to its reliance on actual purchasing behavior and intention to convey the most accurate information. The larger fraction for the beverages message ( $3/4$ ) would likely have a larger impact than the fraction used in the chips message ( $2/3$ ), but that was beyond the control of the experimenters. Also, it is worth noting with already over three fourths of the cafeteria patrons choosing diet soda or water (green beverages) as compared to less than one fourth choosing regular soda, there was less room for improvement than there was with the chips, where nearly one third of the sales came from red-tagged chips. The signs were in place for three weeks, until close of business on Monday, June 18, 2012.

**Phase 11: Washout – only price changes and colored-nutrition labeling.** On Tuesday, June 19, 2012, the two social norm message signs were removed, returning the cafeteria to phase 3 conditions. Data continued to be collected; this washout lasted three weeks, through Monday, July 9, 2012.

**Phase 12: Healthy substitute pairing (and price changes and colored-nutrition labeling).** On Tuesday, July 10, 2012, the healthy substitute pairing intervention began for a period of three weeks. Pairing items leverages the benefits of joint evaluation, which encourages a more thoughtful, rational decision based on considering the tradeoffs of the choices. Although we originally anticipated physically placing an unhealthy, red-tagged item next to a similar, potentially substitutable healthy, green-tagged item with a sign suggesting “Instead of this, try this”, we decided to use a sign with colored images of the products for ease of display. Again, we focused our messages on beverages and chips. For beverages, we chose to pair a regular 20-ounce bottled Coca-Cola with a Diet Coke of the same size. Although water was a potential substitute for the regular soda, diet soda was thought to be a closer substitute and also green-

tagged like water. For chips, we paired the red-tagged bag of Doritos Nacho Cheese chips (1.75 ounces) alongside the green-tagged Stacy's Simply Naked Pita chips (1.5 ounces), which are plain pita chips with sea salt. The wording of these two signs is noted below followed by their images (Figure 23-24).

(Beverage) “Instead of a red-tagged beverage like... (picture of a 20-ounce regular Coca-Cola bottle) Try a green-tagged beverage like... (picture of a 20-ounce Diet Coke bottle).”

(Chips) “Instead of a red-tagged bag of chips like... (picture of a bag of Doritos Nacho Cheese chips) Try a green-tagged bag of chips like... (picture of a bag of Stacy's Simply Naked Pita chips).



*Figure 23: Paired Substitution Message for Sodas*





*Figure 24: Paired Substitution Message for Chips*

The signs were in place for three weeks, until close of business on Monday, July 30, 2012.

**Phase 13: Washout – only price changes and colored-nutrition labeling.** On Tuesday, July 31, 2012, the two paired substitution signs were removed, returning the cafeteria to phase 3 conditions. Data continued to be collected; this washout lasted three weeks, through Monday, August 20, 2012.

**Phase 14: Grouping by healthfulness (and price changes and colored-nutrition labeling).** On the evening of Monday, August 20, 2012, items in the cafeteria were re-arranged in preparation for the grouping by healthfulness intervention, which was to start Tuesday, August 21. We planned to organize items within their respective food categories (like beverages) into discrete, labeled colored sections such that all green, healthy beverages would be grouped



together on a shelf with a sign over them indicating that they were the green beverages. Green items, to the extent possible, would also be slightly easier to reach or closer to the consumer and eye level when possible as compared with yellow and red items.

We determined to focus, again, on beverages and chips. All bottled beverages in the two cold beverage cases—one for Pepsi products and one for Coca-Cola products—were arranged with all the green beverages in the farthest right compartment, closest to the consumer. For the three-door Coca-Cola beverage case, the red beverages were placed in the middle and the far right door included canned beverages at the top (unlabeled, as regular and diet 12-ounce canned beverages could not be differentiated at the register and were not part of our intervention) and the few yellow beverages at the bottom. (Figure 25). For the two-door Pepsi beverage case, the right compartment, as mentioned, contained all green beverages and the left compartment included red beverages at the top and the few yellow beverages down at the bottom. (Figure 26). Large signs were pasted on the doors of the cases; for each case, three signs were affixed to the door to indicate green beverages, three for red beverages, and one for yellow beverages, as yellow beverages for both Coca-Cola and Pepsi were few in number. Photos were taken to share with the Coca-Cola and Pepsi distributors to inform them of the new layout for the beverage cases, as the distributors came a couple times each week to re-stock the cases.



*Figure 25: The Coca-Cola Display Case with Grouping Signs*



*Figure 26: The Pepsi Display Case with Grouping Signs*

For the two chip racks, chips were arranged on with green chips on the top racks, near eye level, then yellow chips below them, and red chips on the bottom near the floor, requiring one to bend over to select a red-tagged bag of chips. One sign of each color was placed on each of the racks to identify the color categories. (Figure 27).



*Figure 27: The Chip Display with Grouping Signs*

On Tuesday, August 21, 2012, the first day planned for the intervention, the Pepsi distributor who services the cafeteria re-arranged the beverages back to their previous arrangements. The experimenters had not anticipated the distributors would have had an opportunity to re-arrange the beverages before the distributors had been contacted and presented the pictures and plan for the new layout. Upon learning what had occurred with the Pepsi

products, we emailed both the Pepsi and Coca-Cola distributors to inform them of the intervention and provide pictures of the intended layout for their respective beverage cases. Both distributors replied that they would comply with the new plans for the beverage cases.

We decided to omit the period from Tuesday, August 21 through Friday, August 31 while the beverage case layout was being discussed and put into place. The data collection for this intervention officially began on Monday, September 3, 2012, for a period of five weeks, ending on Friday, October 5, 2012. Over the course of the intervention, the beverage cases were periodically checked to ensure the beverages were in their proper places.<sup>45</sup>

**Phase 15: Washout – only price changes and colored-nutrition labeling.** On Monday, October 8, 2012, the beverages and chips were re-arranged into their previous layout, so that they were not separated into categories by colors or healthfulness and the cafeteria was returned to phase 3 conditions. The re-arrangement took several days to be completed, so for data collection purposes, October 8-10, 2012, were omitted and the washout officially began on Thursday, October 11, for a period of just over four weeks, through Friday, November 9, 2012.

**Phase 16: Final Phase – only price changes with colored-nutrition labeling removed.** The final phase, which began on Monday, November 12, 2012, removed all colored-labels from food items. The cafeteria did not return entirely to its originally state, as the price changes—including the increase price for regular soft drinks and the decreased price for water—remained in effect. However, this allowed us to return to a pre-color labeled condition and return the

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<sup>45</sup> Occasionally, a few items were found to be mislabeled. For instance, on Wednesday, September 5, some water was labeled yellow rather than green and Brisk Tea was inaccurately labeled green; on Wednesday, September 26, one row of water was again labeled yellow and one column of soda was mislabeled. However, these errors were quickly noted and fixed by the cafeteria staff.

cafeteria to its final state. Data was collected for a period of five weeks, through Friday, December 14, 2012.

### **Data Collection and Measures**

Prior to data collection, the researchers coordinated with the cafeteria business manager to determine the feasibility of desired changes and programming to the cash registers for data collection and analysis purposes. For instance, on March 15, 2011, when the price of sugary soft drinks increased by 25 cents, a new button was programmed on the cash registers for “sugar-added beverages”, so as to distinguish between sugary beverages and the lower priced diet beverages and water, the latter two of which continued to share one button on the register. Similarly, on October 3, 2011, when the price of bottled water decreased by 25 cents, a new button was created to differentiate between water and diet beverages. However, between March 15, 2011, and October 2, 2011, the cash registers used only one button for diet beverage and water purchases.<sup>46</sup> Thus, it is not possible to distinguish between diet beverage and water purchases during this time period. Throughout the study, the daily register journals, a compilation of all the register receipts for a given register from a one-day time period, were uploaded the following morning to the database system at the hospital. (Figure 28). These were either exported in zip files periodically to the researchers or the researchers would physically go to the computer at the hospital and upload the files to a zip drive to copy the files. The data was run through a Perl code to pull the data of interest out of the registry journals. The data we collected from the receipts included: the transaction number, the register number, the date, the

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<sup>46</sup> Although prior studies mention training the cafeteria cashiers in the new registering method and ensuring accuracy by using anonymous shoppers (Block et al., 2010; Thorndike et al., 2012), we did not incorporate such techniques given that only one new key was added in March 2011 and one new key in October 2011.

time, the name of the item purchased, the item price, the number of a given item that was purchased, the total number of items purchased, whether an item was returned, the payment form (credit card, cash, employee badge), credit card type, the amount paid, the subtotal, the tax, whether an employee badge was used to pay, the employee discount amount in dollars when an employee badge was used, and the balance left on the employee badge when an employee badge was used.<sup>47</sup> There were several other items on the receipt that we collected for the sake of being thorough, but these have no bearing on the analysis and will be omitted from discussion.

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<sup>47</sup> If an employee stored money on her employee identification badge and paid with her badge, she would receive a 5% discount on the purchase price of items in the cafeteria.

Chk 2202	
CE: 144	CC: 3 TC: 3
Trn 5289	Oct12'12 07:38AM

---

C h e c k	
1 Bagel w/cheese	1.19
1 Cream Cheese	0.25
2 Boiled Egg	1.18
Cash	20.00
Subtotal	2.62
+ Tax	0.17
Amount Paid	2.79
Change Due	17.21

---

REFERENCE NUMBER: 98342

Chk 2203	
CE: 144	CC: 3 TC: 3
Trn 5290	Oct12'12 07:38AM

---

C h e c k	
1 Milk Bottled	1.19
5 %	
Badge disc	0.06-
BAL	0.77
Badge Pay	1.20
Subtotal	1.13
+ Tax	0.07
Amount Paid	1.20

---

Chk 2207	
CE: 144	CC: 3 TC: 3
Trn 5294	Oct12'12 07:40AM

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C h e c k	
Date:	Oct12'12 07:40AM
Card Type:	MC
Acct #:	XXXXXXXXXXXX9610
Exp Date:	XX/XX
Auth Code:	664156
Check:	2207
Server:	144 Melinda

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Total	6 . 9 2
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Figure 28: Sample Register Journal

Since we stored the data at the item level, we also created a unique identifier number for each transaction that would identify all purchases from a given transaction, as none of the

numbers from the receipts themselves, not even the transaction number, were reliable unique identifiers.

Once the file was created, it was merged with an excel file that contained the color-coding information, so as to label an individual item as green, yellow, or red. In addition, before analysis, variables for the day of the week, week number, hour of the day, and intervention phase number were created and identifiers for beverages and chips added. Also, items that were returned in a transaction were removed, along with the original item.

Following Cinciripini (1984) and Thorndike, et al. (2012), the primary outcome is sales of “green,” “yellow,” and “red” beverages and chips in each phase and specifically the proportion of healthy sales (green and yellow) to all sales (green, yellow, and red) in each phase. Yellow beverages, which made up a very small portion of beverages (< 10%), were not included in the analyses, so the beverage analysis was effectively the proportion of green beverages to green and red beverage sales in each phase while the chip analysis was the proportion of green and yellow chips to green, yellow, and red chip sales.<sup>48, 49</sup> We refer to the proportion of green beverages to green and red beverage sales as the percentage of healthy beverages. Similarly, we refer to the proportion of green and yellow chips to total chip sales as the percentage of healthy chips.

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<sup>48</sup> We are effectively treating “green” as the healthy group and “red” as the unhealthy group for beverages while we are considering “green” and “yellow” items as the healthy group and “red” items as the unhealthy group for chips. The decision to group “green” and “yellow” chips together, in particular, comes from the fact that both Baked Chips, a “green” item, and Sun Chips, a “yellow” item, share the same code on the computer and thus, sales of those two items cannot be parsed. Hence, the need to treat “green” and “yellow” as one category.

<sup>49</sup> The same beverage analysis was conducted on only diet soft drinks and regular soft drinks, without water, from phase 3 forward when water and diet sodas were distinguishable by different register keys and the findings were essentially the same. Therefore, we report the findings using all 3 sets of beverages—water, diet soft drinks, and regular soft drinks.



For the purpose of analyses, the beverage categories consisted of bottled regular soda, bottled diet soda, and bottled water.<sup>50</sup> Red beverages included regular soft drinks, which were defined as 20-ounce caloric containing carbonated beverages (e.g., Coca-Cola, Pepsi). Green beverages were comprised of diet soft drinks, which were defined as carbonated beverages without calories (e.g., Diet Coke, Sprite Zero, Diet Cherry Pepsi), and zero-calorie non-flavored or artificially flavored bottled water. For bottled water, we used the register code for Dasani 20-ounce bottled water and a register code for "Bottled Water 20oz.", a generic water key for other non-specialty, 20-ounce bottled water. Both of these waters were in the cafeteria for the duration of the study, were coded green on August 15, 2011, with the color-labeling phase, and changed in price with the water price intervention on October 3, 2011, from \$1.17 (\$1.25 with tax) to \$1.41 (\$1.50 with tax).<sup>51</sup>

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<sup>50</sup> Fountain drinks are not sold in this cafeteria; as such, we did not have to worry about accounting for fountain drink sales, which can be problematic given that a cashier may not know what a customer put in a cup. Prior work has found it difficult to rule out substitution effects, customers opting for regular fountain drinks to avoid price increases on regular bottled soda, given an inability to control for these sales (Block et al., 2010; Jue et al., 2012).

<sup>51</sup> For several reasons, we chose to exclude other forms of water including Mineral Water, Vitamin Water and Vitamin Water Zero, Dasani 1 Liter, and Evian bottled water. Mineral Water was priced at \$1.89 (\$2.01 with tax) and was in the cafeteria at the start of the study (March 15, 2011) and was discontinued after November 17, 2011. Consequently, we excluded it based on the price difference compared to regular bottled water and the abbreviated duration in the cafeteria.

Vitamin Water Zero, a "green" water, and Vitamin Water, a "yellow" water due to the caloric and sugar content, were introduced in the cafeteria on November 17, 2011, after the water price intervention had started. They were priced at \$1.89 before tax (\$2.01 with tax), a price that did not change. We excluded both Vitamin Water products due to the price difference and the fact that they were made available in the cafeteria only after the study period had begun. (Vitamin Water and Vitamin Water Zero were also not included in the analyses due to the fact that Vitamin Water was labeled yellow and Vitamin Water Zero was labeled green, and the two were not differentiated by the register until December 7, 2012, near the end of the study.)

Dasani 1 Liter bottled water was priced at \$1.99 (\$2.12 with tax) for the duration of the experiment; we excluded it due to its higher price and the fact that its price did not decrease during the water price intervention.

Evian water was priced at \$1.69 (\$1.80 with tax) at the start of the study and decreased to \$1.41 (\$1.50 with tax) with the water price intervention on October 3, 2011 for the duration of the study. We excluded Evian due to its higher price point, even though its price decreased during the water intervention as it did not decrease to the level of the other bottled waters (\$1.17, which is \$1.25 with tax) and was priced the same as diet beverages. However, had we included Evian water, the number purchased only amounted to 633 during the 433 days of study, over half of

For the chip categories, red chips included all regular chips (e.g., Doritos Nacho Cheese, Cheetos, and Fritos); yellow chips consisted of pretzels and Sun Chips, the latter of which included several varieties; green chips included pita chips and all baked chip varieties. We excluded Kettle chips from the analysis, given that only a single purchase of 25 occurred in the cafeteria on June 7, 2012 and the chip code appears nowhere else in the data, suggesting that they were never a regular cafeteria item. We also excluded Combos snacks and Gardettos snack mixes, even though they might be possible substitutes for chips. However, only 18 bags of either Combos snacks or Gardettos snacks were purchased during the entire study, so they do not appear to be of importance to our analysis or theoretical understanding given their small sales volume.

The primary chip purchases we were forced to exclude and which are of interest for our analysis include chips bought as part of a discounted combo meal. Combo meals come with either a chip or a fruit for an additional 59 cents before tax (63 cents after tax), but the registry code for this additional item appears only as “Chips/Fruit Combo,” which fails to allow us to differentiate between chip and fruit purchases or to identify the color label of the chips. During the study period, a total of 13,955 of these meal combos (either a piece of fruit or a bag of chips at a discounted price) were purchased. However, by removing chip purchases that were purchased at a discounted rate, we are at least separating the effects of our interventions from potential price effects that could affect the choice of the type of chip (or even the choice between a bag of chips and a piece of fruit). Given that our chips range in price from 89 cents to \$1.13

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which were purchased in the first phase. This is compared with, for example, over 8 times as many bottles (5,191) of 20-ounce Dasani for the entire study and 7,370 non-Dasani bottled waters from phase 3 to the end of the study (and presumably far more for the full duration of the study, since non-Dasani bottled waters only had a unique key from phase 3 forward with the water price change. Prior to phase 3, these bottled waters were included with diet beverages, which does not affect our analysis since bottled waters and diet sodas are included in green beverages, but we are unable to determine the exact number of non-Dasani bottled waters that were purchased during phases 1 and 2). Thus, Evian water would not have significantly affected our results.

(95 cents to \$1.20 after tax), and given that only regular chips, our red chips, are priced the highest at \$1.13 (\$1.20 after tax), a consumer would be saving the most money by choosing a red-tagged bag of chips as part of a meal combo as compared to green chips (which range from 89 cents for baked chips (96 cents after tax) to \$1.09 for pita chips (\$1.16 after tax) or yellow chips (which are 89 cents, for both pretzels and sun chips, and 96 cents after tax). Red chips, and indeed any of the chips, are also a better deal than fruit, originally priced at 65 cents before tax (70 cents after tax) prior to January 11, 2012, after which point they were 69 cents before tax (73 cents after tax). Those choosing a fruit as part of a combo only saved a few cents (6 or 10 cents), given the price difference of a taxed combo item (63 cents) and regular taxed fruit (which was 69 cents through January 10, 2012 and then 73 cents for the rest of the study).

### **Analysis**

For preliminary analyses, we ran t-tests to determine the mean percentages of healthy beverages and chips sold in each phase, and report these means in a table (Table 7) along with the means showing absolute changes in sales data. However, it is the latter, the mean percentage of healthy beverages and chips sold, which are used in our regressions—not the mean changes in absolute sales numbers—which we discuss below.

Similar to Block et al. (2010) and Thorndike et al. (2012), we conducted a series of regressions taking both the percentage of healthy beverage sales and percentage of healthy chip sales, at the day level, as the dependent variable. The experimental phase coded as a dichotomous dummy variable served as the main independent variable. We controlled for the day of week (M-F) to control for any potential sales variation by day. We also controlled for total beverage sales by day and total chips sales by day in the respective regressions. We did not

control for total number of unique transactions by day due to the high correlation with beverage sales ( $r = .85$ ,  $p = 0$ ,  $n = 433$ ) and chip sales ( $r = .54$ ,  $p = 0$ ,  $n = 433$ ), respectively. We did not control for holidays, as the cafeteria is closed on holidays and no data is collected that day. We did not control for month, as many of the interventions and washouts were only three weeks in length, therefore occurring entirely in the span of only one or two different months and thus, correlating closely with a given month. However, natural differences in food preferences and therefore consumer purchases could occur merely based on seasonal factors and atmospheric (weather) conditions. Such differences will be at least partially controlled for by conducting analyses that compare intervention phases with the washout phase directly prior (when applicable) as will be explained in the subsequent paragraph, as washouts occur proximally and essentially in the same season (Cinciripini, 1984; Zifferblatt, Wilbur, & Pinsky, 1980). We also did not control for year, as though we had data from 2010, the data for the analysis was wholly within 2011 and 2012, with the baseline data being entirely in 2011. We excluded data from several dates, as previously noted, before and after the grouping phase, due to problems setting up and taking down the intervention. These dates were August 21-31, 2012 and October 8-10, 2012.

We ran regressions comparing each phase to the phase that preceded it, which for even phases 6 (health message I) and following meant a washout phase (as the first washout phase occurred in phase 5). This helps to control for seasonality and also the potential cumulative effects of interventions, which might not be accounted for by comparing to one, earlier static baseline, but which may be covaried out by comparing each intervention to its own individualized baseline, one phase prior (Barlow & Hayes, 1979; Cinciripini, 1984). This also means that all phases are compared to phases directly before and after them. It is helpful to

compare an intervention phase with not only the washout before it as previously discussed, but also the washout after it, which allows us to determine if the washout did indeed “wash out” or remove the effects of that intervention.

In addition, all phases subsequent to and including phase 4 (emoticons) were compared to a static baseline condition that would allow an assessment of the impact of each intervention relative to each other. However, we are mindful that this analysis does not take into account any persistent or carryover effects of previous interventions on subsequent interventions. The baseline consisted of the phase 3 water price change, which appeared to be a suitable baseline given that it included the changes in phase 1 (soda price increase) and phase 2 (colored-nutrition labeling) and was the last experimental intervention to involve a change that was carried through for the duration of the other experimental conditions.<sup>52</sup>

Thus, the first regressions we conducted compared each phase to the phase directly before it (phase 2 to phase 1, phase 3 to phase 2, and so on), which for even phases 6 and following was a washout phase. The second set of regressions we performed compared each phase to the baseline phase 3, for all phases beyond phase 3. (Phases 1 and 2 were not involved in this set of regressions). We present regression tables for the significant intervention phases and discuss the impact of the intervention (based on the coefficient of the phase variable) with 95% confidence intervals (CIs) using the standard errors.

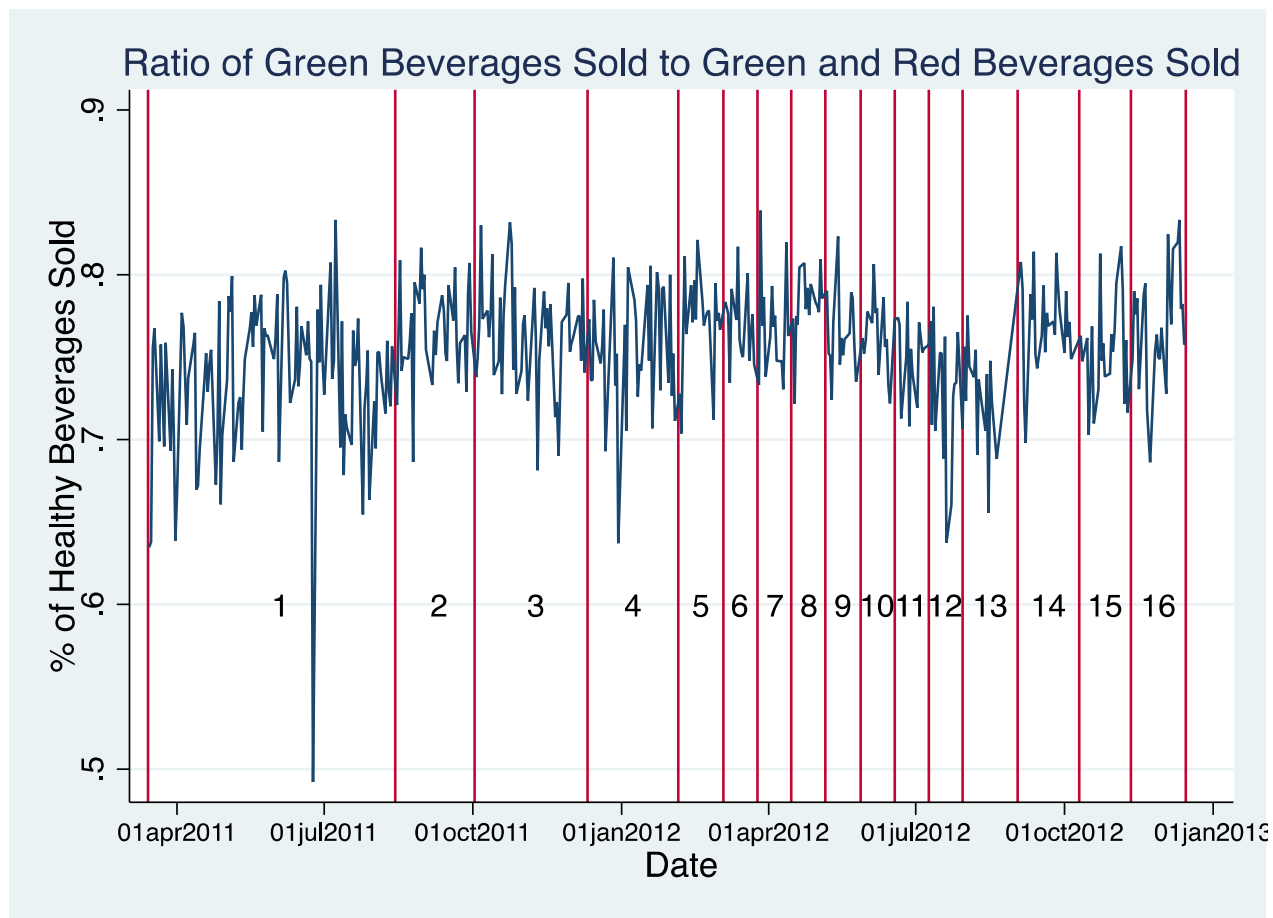
We conducted all analyses with the STATA version 12.1-MP (StataCorp, College Station, TX).

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<sup>52</sup> Ideally, we might have used as another baseline the year of data prior to the first intervention, which could have helped to control for seasonality as well. However, although we obtained the data, the different beverages and chips were not identifiable as the same key was used to indicate regular soft drinks, diet soft drinks and bottled water while all the chips used one key.

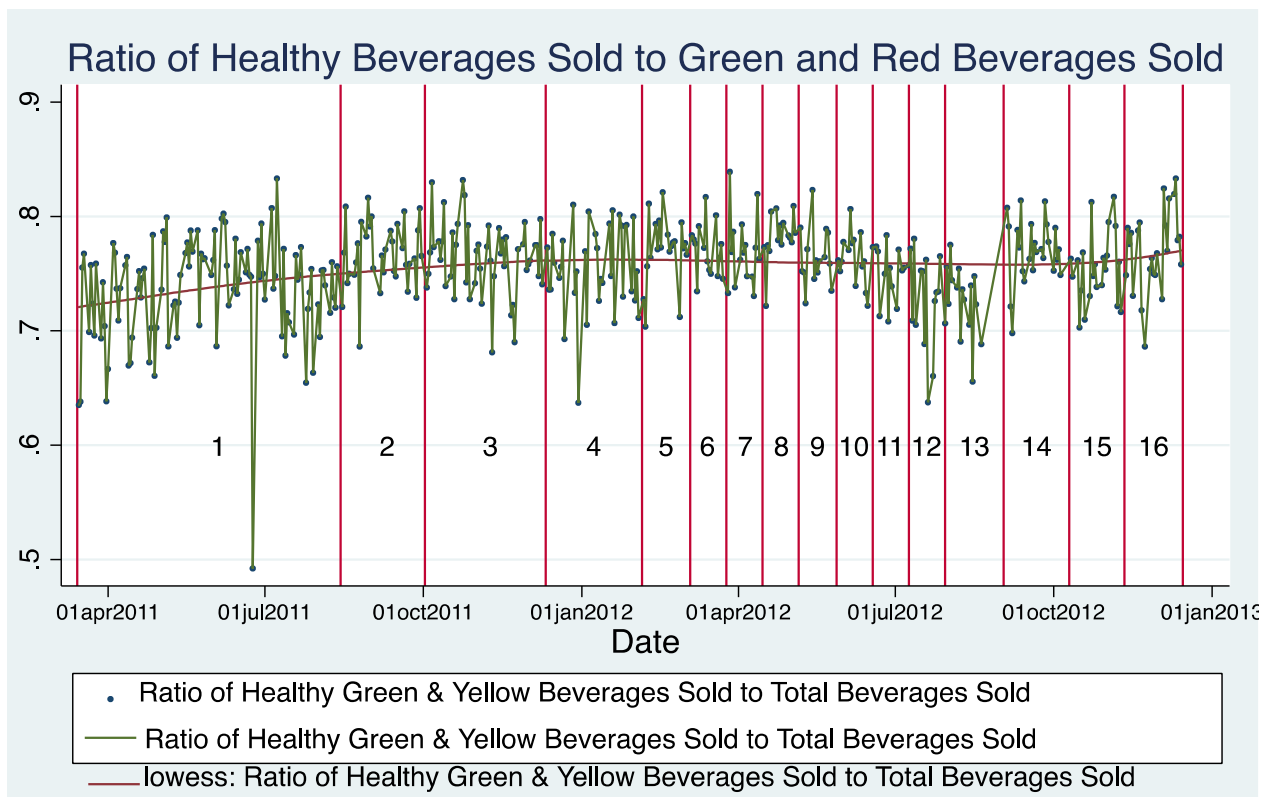
## Results

Figure 29 displays the daily percentage of healthy beverage sales across the study period, showing how each intervention affects the ratio of healthy beverage sales to total sales for each phase (vertical lines separate each phase, including washouts). Figure 30 depicts the same graph with a lowess curve superimposed over the data points. Lowess is a nonparametric smoothing technique that provides a great deal of flexibility in representing the structure of the dataset and does not assume any particular relationship (e.g., linear) between the variables (Jacoby, 2000). Using lowess allows us to overcome the random noise in the data to extract the underlying trend. Similar to Figures 29 for beverages, Figure 31 plots the daily percentage of healthy chip sales across the study period while Figure 32, like Figure 30, fits a lowess curve to the data.



Phase	Intervention
1	Soda Price
2	Colored-Nutrition Labels
3	Water Price
4	Emoticon
5	Washout
6	Health Message I
7	Washout
8	Health Message II
9	Washout
10	Social Norm
11	Washout
12	Healthy Substitute Pairing
13	Washout
14	Grouping by Healthfulness
15	Washout
16	Remove Color Labels

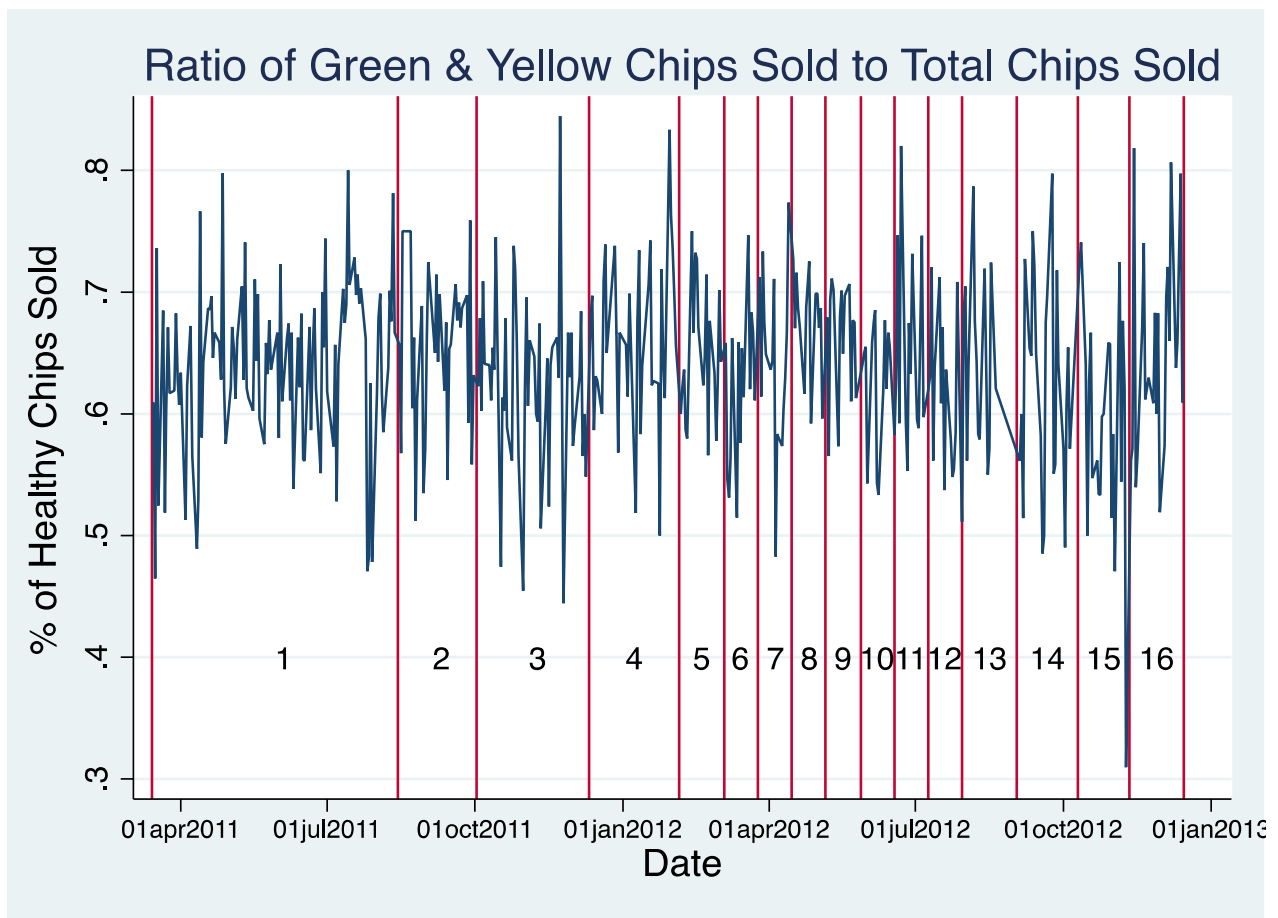
Figure 29: Ratio of Green Beverages Sold to Green and Red Beverages Sold During the Study Period, with Vertical Lines Indicating the Start and End of Each Phase



Phase	Intervention
1	Soda Price
2	Colored-Nutrition Labels
3	Water Price
4	Emoticon
5	Washout
6	Health Message I
7	Washout
8	Health Message II
9	Washout
10	Social Norm
11	Washout
12	Healthy Substitute Pairing
13	Washout
14	Grouping by Healthfulness
15	Washout
16	Remove Color Labels

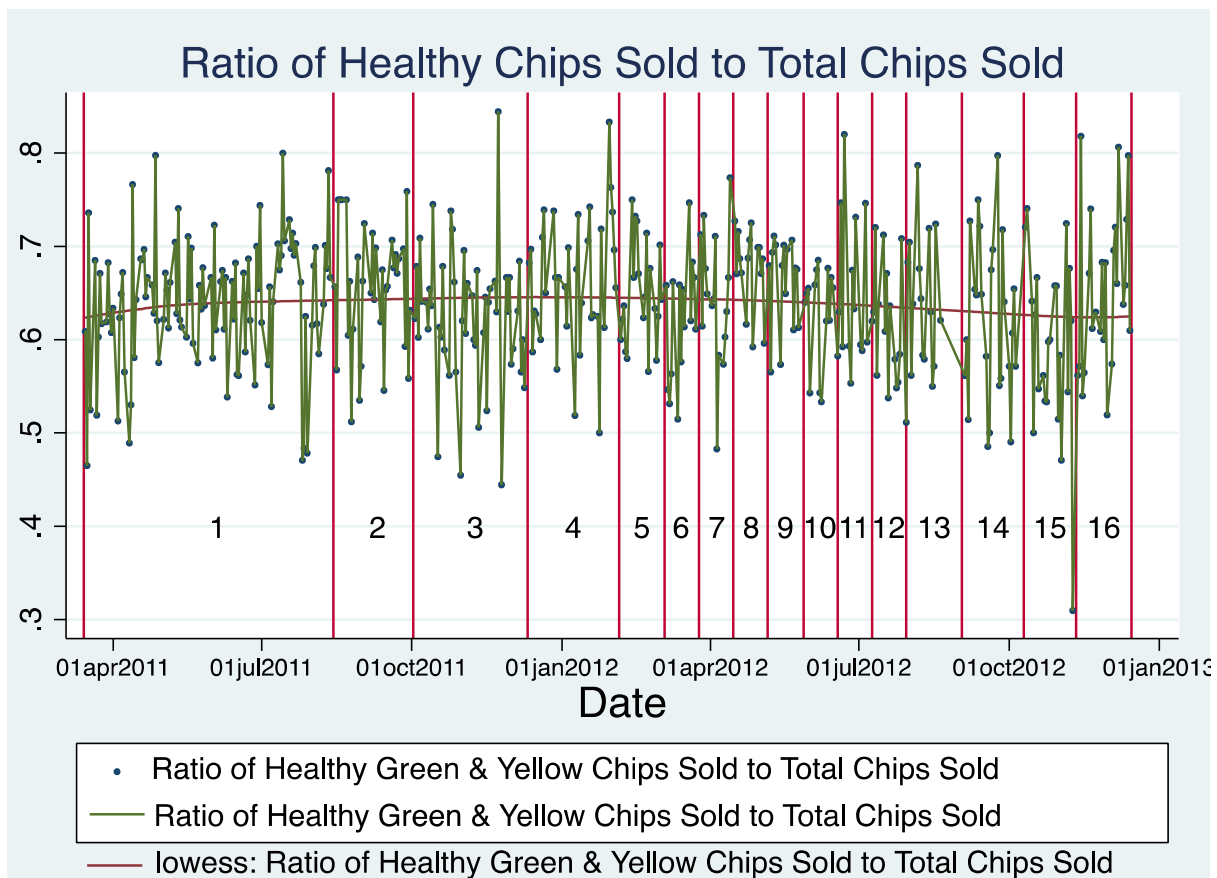
*Figure 30: Lowess Curve Fitted to the Graph Plotting the Ratio of Green Beverages Sold to Green and Red Beverages Sold During the Study Period, with Vertical Lines Indicating the Start and End of Each Phase*





Phase	Intervention
1	Soda Price
2	Colored-Nutrition Labels
3	Water Price
4	Emoticon
5	Washout
6	Health Message I
7	Washout
8	Health Message II
9	Washout
10	Social Norm
11	Washout
12	Healthy Substitute Pairing
13	Washout
14	Grouping by Healthfulness
15	Washout
16	Remove Color Labels

*Figure 31:* Ratio of Green and Yellow Chips Sold to Total Chips Sold During the Study Period, with Vertical Lines Indicating the Start and End of Each Phase



Phase	Intervention
1	Soda Price
2	Colored-Nutrition Labels
3	Water Price
4	Emoticon
5	Washout
6	Health Message I
7	Washout
8	Health Message II
9	Washout
10	Social Norm
11	Washout
12	Healthy Substitute Pairing
13	Washout
14	Grouping by Healthfulness
15	Washout
16	Remove Color Labels

*Figure 32: Lowess Curve Fitted to the Graph Plotting the Ratio of Green and Yellow Chips Sold to Total Chips Sold During the Study Period, with Vertical Lines Indicating the Start and End of Each Phase*

Table 7 below shows the descriptive statistics of the variables in the regression equations, after missing phases and pre-intervention data were removed from the data set. For the 433 days of data used across analyses, there were on average 1,219 unique transactions per day ( $SD=129$ ). The average number of beverages sold on a given day was 406 ( $SD= 51$ ) and the mean percentage of healthy beverage sales was 75.5% ( $SD= 3.82\%$ ). The average number of chips sold daily was 73 ( $SD= 14$ ) and the average percentage of healthy chip sales was 64% ( $SD= 7.20\%$ ). In terms of correlations, the main correlation that appeared problematic for our regression with a correlation over .8, as we noted earlier, was that of daily number of unique transactions and daily number of beverage sales ( $r=.85, p= 0, n= 433$ ). It is not surprising that the two would be highly correlated. We had intended to control for both in our regression for beverages (and to control for daily number of unique transactions and daily number of chip sales in our regression for chips). But this level of correlation between the two variables indicates that controlling for each would be redundant and impact our model, so we removed daily number of unique transactions from both the beverage and chip regression. The correlation between daily number of unique transactions and daily number of chip sales was high, but not nearly as strong a correlation ( $r=.54, p= 0, n= 433$ ). We removed it from the chip model to keep our models similar. The only other particularly high correlation was that for daily number of beverage sales and daily number of chip sales ( $r= .60, p= 0, n= 433$ ). This is not surprising that the number of sales of two items might be correlated with each other, especially when they are something like beverages and chips which are clearly not substitutes and likely complements. It is also not problematic for us since these two variables, the daily number of beverage sales and daily number of chip sales, are used in different regressions, for beverage and chip analyses,

respectively. We present the whole correlation table for review and now discuss the regression results of the beverage analyses followed by the regression results from the chip analyses.

Table 7: Descriptive Statistics and Correlations Between the Variables

Variable	N	Mean (SD)	Min	Max	Healthy Bev Sales, %	No. of Bev Sales	Healthy Chip Sales, %	No. of Chip Sales	No. of Unique Trans	Phase1- Econ Soda Price	Phase2- Colors
Healthy Bev Sales, %	433	75.50 (3.82)	49.22	83.9	1						
No. of Bev Sales	433	406 (51)	85	520	0.04	1					
Healthy Chip Sales, %	433	63.99 (7.20)	30.95	84.44	0.05	0.04	1				
No. of Chip Sales	433	73 (14)	18	130	0.06	0.60***	-0.06	1			
No. of Unique Transactions	433	1219 (129)	249	1462	0.16***	0.85***	0.03	0.54***	1		
Phase1- Econ Soda Price	107	.25(.43)	0	1	-0.3***	0.16***	-0.002	0.18***	0.02	1	
Phase2- Colors	34	.08(.27)	0	1	0.09	-0.006	0.07	-0.02	-0.02	-0.17***	1
Phase3- Water Price	21	.11(.32)	0	1	0.09	-0.08	-0.08	-0.04	-0.22***	-0.20***	-0.10*
Phase4- Emoticons	35	.08(.27)	0	1	0.002	-0.26***	0.09	-0.21***	-0.25***	-0.17***	-0.09
Phase6- Health Message I	15	.03(.18)	0	1	0.8	-0.01	-0.05	0.05	-0.004	-0.11*	-0.06
Phase8- Health Message II	15	.03(.18)	0	1	0.13**	0.02	0.10*	0.07	0.06	-0.11*	-0.06
Phase10- Social Norms	15	.03(.18)	0	1	0.04	0.07	-0.03	0.11*	0.11*	-0.11*	-0.06
Phase12- Pairing	15	.03(.18)	0	1	-0.14**	0.10*	-0.07	0.10*	0.07	-0.11*	-0.06
Phase14- Grouping	23	.05(.23)	0	1	0.09	0.04	-0.05	-0.07	0.16***	-0.14**	-0.07
Phase16- Final Phase	24	.06(.23)	0	1	0.10*	-0.11*	0.05	-0.14**	0.03	-0.14**	-0.07
Monday	133	.19 (.39)	0	1	-0.006	-0.22***	-0.01	-0.001	-0.20***	-0.01	-0.01
Tuesday	146	.20(.40)	0	1	0.16***	0.01	-0.06	0.14**	0.07	0.003	0.002
Wednesday	144	.20(.40)	0	1	-0.05	0.28***	0.12**	0.08	0.24***	0.003	0.002
Thursday	143	.20(.40)	0	1	0.04	0.23***	0.03	0.19***	0.25***	0.003	0.002
Friday	142	.20(.40)	0	1	-0.14**	-0.32***	-0.09	-0.40***	-0.37***	0.003	0.002

Table 7: (Continued)

[illegible]

## Beverage Sales

We will discuss beverage sales first followed by chip sales. Table 8 below presents the intervention phases along with their corresponding mean percentage of daily healthy beverage sales, mean number of beverages per day, and results of the t-tests comparing a given phase to the baseline phase 3 and the washout phase immediately preceding it, when applicable.

Table 8: *Percentage of Healthy Beverage Sales and Absolute Sales Across Interventions*

Phase No.	Phase Name	N	Mean Healthy Bev % (SD)	Mean^ No. Bev Per Day	Baseline Phase 3 t-test	Washout Before t-test
1	Soda Price	107	73.53 (.05)	420		
2	Colors	34	76.66 (.03)	405		Compared to Phase 1: $t(139)= 3.70^{***}$
3	Water Price	49	76.42 (.03)	394		Compared to Phase 2: $t(81)= 0.34$
4	Emoticons	35	75.52 (.04)	362	$t(82)= 1.19$	
6	Health Msg I	15	77.02 (.02)	404	$t(62)= 0.69$	$t(33)= 0.10$
8	Health Msg II	15	78.20 (.02)	411	$t(62)= 2.06^*$	$t(28)= 1.28$
	Cumulative Health Msg II					Compared to Washout 5: $t(33)= 1.21$
10	Social Norms	15	76.38 (.02)	423	$t(62)= 0.05$	$t(28)= 0.06$
12	Pairing	15	72.57 (.04)	432	$t(62)= 3.86^{***}$	$t(27)= 2.03^*$
14	Grouping	23	76.87 (.03)	415	$t(70)= 0.60$	$t(36)= 4.40^{***}$
	Cumulative Grouping					Compared to Phase 1: $t(129)= 3.55^{***}$
16	Remove all	24	77.10 (.04)	383	$t(71)= 0.84$	$t(44)= 1.68$

^ Mean number of beverages per day has been rounded according to rounding rules

\*Significant at  $p < 0.05$ , \*\*Significant at  $p < 0.01$ , \*\*\*Significant at  $p < 0.001$

Given that the increase in soda price was the first phase for which we had data, we could not assess the impact of that intervention relative to an earlier baseline and therefore cannot assess the impact of that intervention. However, the subsequent phase, the colored-nutrition label phase, significantly increased sales of healthy beverages compared to the phase directly before it (soda price increase), raising the mean percentage of healthy sales by 3.13 percentage points from 73.53% ( $SD = .05$ ) to 76.66% ( $SD = .03$ ,  $p < 0.001$ ). (As there was not a washout phase after this phase, we do not discuss whether the effects were washed out.)

The second health message, the exercise message related to the amount of walking one must do to burn off the calories in a regular soda, increased sales of healthy beverages ( $M = 78.20\%$ ,  $SD = .02$ ) by 1.78 percentage points compared to the phase 3 baseline ( $M = 76.42\%$ ,  $SD = .03$ ,  $p = 0.04$ ). (However, this increase was not statistically different from the washout phase before it ( $M = 76.97\%$ ,  $SD = .03$ ,  $p = 0.21$ )). The percentage of healthy beverage sales dropped 1.77 percentage points in the washout after the second health message phase ( $M = 76.43\%$ ,  $SD = .02$ ,  $p = 0.04$ ), suggesting that the washout did remove the effects of the second health message phase. When considering the cumulative effect of the two health messages, we compared the second health message ( $M = 78.20\%$ ,  $SD = .02$ ) with the washout phase before the first health message ( $M = 77.12\%$ ,  $SD = .03$ ). Given that the mean percentage of healthy beverages sales was only 1.08 percentage points higher in the second health message phase, there was no significant difference between the two phases ( $t(33) = 1.21$ ,  $p = 0.23$ ).

The healthy substitute pairing phase, contrary to our prediction, significantly decreased the mean percentage of healthy beverage sales to 72.57% ( $SD = .04$ ), which was 3.85 percentage points below the phase 3 baseline ( $M = 76.42\%$ ,  $SD = .03$ ,  $p < 0.001$ ) and 2.58 percentage points below the washout phase directly before it ( $M = 75.15\%$ ,  $SD = .02$ ,  $p = 0.05$ ). The washout phase



directly after the pairing phase maintained the same reduced percentage of healthy beverage sales ( $M= 72.71\%$ ,  $SD= .03$ ,  $p= 0.92$ ), which continued to be significantly different from the phase 3 baseline ( $p< 0.001$ ). The grouping by healthfulness phase brought the mean percentage of healthy beverage sales up significantly from that washout phase by 4.16 percentage points ( $M= 76.87\%$ ,  $SD= .03$ ,  $p< 0.001$ ) and higher than the phase 3 baseline ( $M= 76.42\%$ ,  $SD= .03$ ), though not significantly so ( $p= 0.55$ ).

To assess the cumulative effects of all the interventions, we compared the grouping phase to the first intervention phase, the soda price increase. The mean percentage of healthy beverages sales in the grouping phase ( $M= 77.04\%$ ,  $SD= .027$ ) was 3.51 percentage points higher than the soda price phase ( $M= 73.53\%$ ,  $SD= .046$ ,  $p< 0.001$ ).

There were no significant changes in the percentage of healthy beverage sales during the other phases, which include the water price, emoticon, first health message (percentage of daily calories), and social norm phases.

Table 9 below further elaborates on our significant findings for beverages, presenting the results of the regressions, which we will summarize here as they offer similar information to the above findings. In comparing the colored-nutrition labeling phase with the phase before it (soda price increase), colored-nutrition labeling was associated with a 3.3% (95% CI= 3.48, 3.12) increase in the mean percentage of healthy beverage sales. The second health message was associated with a 1.7% (95% CI= -.05, 3.5) increase in the mean percentage of healthy beverage sales as compared to the baseline water price decrease phase. In considering the cumulative effect of the health messages, the second health message was associated with a 1.07% (95% CI= -.74, 2.88) increase in the mean percentage of healthy beverage sales as compared to the washout phase before the first health message. This difference was removed by the washout phase after

the second health message, as the regression shows that the mean percentage of healthy beverage sales in the washout following the second health message was 1.74% (95% CI= 3.3, .05, the signs on these terms being negative) lower than the second health message phase right before. In comparing the healthy substitute pairing phase with the baseline water price phase, pairing resulted in a 3.8% (95% CI= 5.8, 1.8, the signs on these terms being negative) decrease in the mean percentage of healthy beverage sales, again a surprising result. The pairing phase also yielded a 2.5% (95% CI= 4.7, .3, the signs on these terms being negative) decrease in mean percentage of healthy beverage sales compared to the washout phase directly before it. The washout after the pairing phase shows that the washout phase did not remove the effects of the pairing phase as compared with the baseline water price phase, as the mean percentage of healthy beverage sales during the washout phase continues to be 3.8% (95% CI= 5.6, 2.0, the signs on these terms being negative) below that of the baseline phase. Finally, the grouping by healthfulness phase was associated with a 4.6% (95% CI= 2.8, 6.4) increase in the mean percentage of healthy beverage sales compared to the washout directly before it, which as we noted had maintained the drop in healthy beverage sales that began in the pairing phase.

Table 9: Regression Tables for Significant Beverage Interventions

VARIABLES	Color vs. Soda Price Before	VARIABLES	HealthMsgII vs Baseline	VARIABLES	Washout after HealthMsgII vs HealthMsgII	VARIABLES	Pairing vs Baseline
Color Label	0.033*** (-0.009)	HealthMsgII	0.017* (0.009)	Washout after HealthMsgII	-0.017** (0.008)	Pairing	-0.038*** (0.010)
Beverage	0 (0)	Beverage	0.000 (0.000)	Beverage	0.000 (0.000)	Beverage	-0.000 (0.000)
Tuesday	0.014 (-0.012)	Tuesday	-0.001 (0.012)	Tuesday	-0.031** (0.013)	Tuesday	0.017 (0.013)
Wednesday	0.002 (-0.013)	Wednesday	-0.013 (0.012)	Wednesday	-0.022 (0.015)	Wednesday	-0.008 (0.014)
Thursday	-0.004 (-0.013)	Thursday	0.003 (0.013)	Thursday	-0.031** (0.015)	Thursday	0.019 (0.014)
Friday	-0.003 (-0.012)	Friday	-0.006 (0.012)	Friday	-0.016 (0.013)	Friday	-0.009 (0.013)
Constant	0.698*** (-0.042)	Constant	0.760*** (0.030)	Constant	0.752*** (0.066)	Constant	0.773*** (0.032)
Observations	141	Observations	64	Observations	30	Observations	64
R-squared	0.118	R-squared	0.102	R-squared	0.328	R-squared	0.295

Standard errors in parentheses

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

Table 9: (Continued)

VARIABLES	Pairing vs Washout Before	VARIABLES	Washout after Pairing vs. Baseline	VARIABLES	Grouping vs Washout Before	VARIABLES	Grouping vs Soda Price (Phase 1)
Pairing	-0.025** (0.011)	Washout after Pairing	-0.038*** (0.009)	Grouping by Healthfulness	0.046*** (0.009)	Grouping by Healthfulness	0.035*** (0.010)
Beverage	-0.000 (0.000)	Beverage	0.000 (0.000)	Beverage	-0.000 (0.000)	Beverage	0.000 (0.000)
Tuesday	0.043** (0.019)	Tuesday	0.014 (0.012)	Tuesday	0.042** (0.019)	Tuesday	0.017 (0.013)
Wednesday	0.010 (0.022)	Wednesday	-0.017 (0.013)	Wednesday	0.024 (0.021)	Wednesday	0.005 (0.014)
Thursday	0.040** (0.019)	Thursday	0.014 (0.013)	Thursday	0.028 (0.018)	Thursday	0.000 (0.014)
Friday	-0.004 (0.018)	Friday	-0.003 (0.012)	Friday	-0.001 (0.015)	Friday	-0.010 (0.012)
Constant	0.795*** (0.077)	Constant	0.754*** (0.029)	Constant	0.816*** (0.075)	Constant	0.721*** (0.052)
Observations	29	Observations	64	Observations	39	Observations	131
R-squared	0.436	R-squared	0.323	R-squared	0.484	R-squared	0.131

Standard errors in parentheses

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

## Chip Sales

Table 10 below presents the intervention phases along with their corresponding mean percentage of daily healthy chip sales, mean number of chips purchased per day, and results of the t-tests comparing a given phase to the baseline phase 3 and the washout phase immediately preceding it, when applicable.

Table 10: *Percentage of Healthy Chip Sales and Absolute Sales Across Interventions*

Phase No.	Phase Name	N	Mean Healthy Chip % (SD)	Mean <sup>^</sup> No. Chip Per Day	Baseline Phase 3 t-test	Washout Before t-test
1	Soda Price	107	63.96 (.068)	78		
2	Colors	34	65.66 (.067)	73		Compared to Phase 1: $t(139)= 1.27$
3	Water Price	49	62.47 (.073)	71		Compared to Phase 2: $t(81)= 2.03^*$
4	Emoticons	35	66.19 (.07)	63	$t(82)= 2.36^*$	
6	Health Msg I	15	62.04 (.064)	77	$t(62)= .20$	$t(33)= 1.41$
8	Health Msg II	15	67.68 (.043)	79	$t(62)= 2.62^*$	$t(28)= 1.42$
	Cumulative Health MsgII					Compared to Washout 5: $t(33)= 1.62$
10	Social Norms	15	62.70 (.052)	82	$t(62)= .11$	$t(28)= 1.91$
12	Pairing	15	61.34 (.067)	81	$t(62)= .54$	$t(27)= 1.39$
14	Grouping	23	62.44 (.087)	69	$t(70)= .01$	$t(36)= .76$
	Cumulative Grouping					Compared to Phase 1: $t(129)= 1.10$
16	Remove all	24	65.37 (.084)	65	$t(71)= 1.52$	$t(44)= 2.29^*$

<sup>^</sup> Mean number of chips per day has been rounded according to mathematical rounding rules

\*Significant at  $p < 0.05$ , \*\*Significant at  $p < 0.01$ , \*\*\*Significant at  $p < 0.001$

As shown in the table, the water price phase significantly decreased the mean percentage of healthy chip sales ( $M= 62.47\%$ ,  $SD= .07$ ) by 3.19 percentage points compared to the prior color phase, ( $M= 65.66\%$ ,  $SD= .07$ ,  $p= 0.05$ ).

In relation to the water price phase, which is the baseline for the subsequent phase analyses, the emoticon phase saw the mean percentage of healthy chip sales jump 3.72 percentage points to 66.19% ( $SD= .07$ ,  $p= 0.02$ ). (It is also worth noting that the mean number of chips sold per day during the emoticon phase, just over 63 bags, was lower during this period than any other period in the study and significantly lower than the phase before it ( $M= 71$  bags,  $p= 0.01$ ). The washout directly after the emoticon phase did not significantly differ in the percentage of healthy chip sales ( $M= 64.89\%$ ,  $SD= .06$ ,  $p= 0.48$ ); however, it was slightly lower such that it no longer differed from the phase 3 baseline ( $M= 62.47\%$ ,  $SD= .07$ ,  $p= 0.19$ ).

The second health message phase (percentage of daily calories of chips) also significantly increased the mean percentage of healthy chip sales by 5.21 percentage points ( $M= 67.68\%$ ,  $SD= .04$ ) compared to the baseline ( $M= 62.47\%$ ,  $SD= .07$ ,  $p= 0.01$ ). However, it did not differ significantly from the washout phase immediately preceding it ( $M= 64.59\%$ ,  $SD= .07$ ,  $p= 0.17$ ), though it was 3.09 percentage points higher. The washout phase after the second health message maintained the same level of percentage of healthy chip sales ( $M= 66.22\%$ ,  $SD= .05$ ,  $p= 0.39$ ) as the second health message phase. When considering the cumulative effect of the two health messages, we compared the second health message ( $M= 67.68\%$ ,  $SD= .04$ ) with the washout phase before the first health message ( $M= 64.89\%$ ,  $SD= .05$ ). Despite the mean percentage of healthy chip sales being up 2.79 percentage points in the second health message phase, there was no significant difference between the two ( $t(33)= 1.62$ ,  $p= 0.11$ ).

The social norm intervention did marginally ( $p = 0.066$ ) decrease the mean percentage of healthful chip sales to 62.70% ( $SD = .05$ ), a 3.52 percentage point drop from the washout phase just prior to it ( $M = 66.22\%$ ,  $SD = .05$ ). In addition, the mean number of chip sales marginally increased ( $t(28) = 1.85$ ,  $p = 0.08$ ) during the social norm phase as compared to the washout before it ( $M = 82$  and  $71$  bags per day, respectively, a mathematical difference of  $10.20$  bags). Upon closer inspection, it appears that this marginal rise in chip sales was due to a significant increase ( $t(28) = 2.52$ ,  $p = 0.02$ ) in red chip sales ( $M = 30$  bags per day) during this phase as compared with the phase before it ( $M = 24$  bags per day) rather than any difference in green chip sales ( $M = 51$  and  $47$  bags per day in the social norm phase and washout phase before, respectively,  $t(28) = 1.02$ ,  $p = 0.31$ ). Thus, while the percentage of healthful chip sales marginally decreased and total volume marginally increased, sales of red chips significantly increased over the washout phase before, which is noteworthy and unexpected. (However, chip sales during this time period did not differ from chip sales from the year prior May 31, 2011-June 20, 2011 (dates adjusted to be comparable to the prior year, removing weekends) ( $M = 80$  bags,  $t(28) = 0.26$ ,  $p = 0.80$ ).)

To assess the cumulative effects of all the interventions, we compared the grouping phase to the first intervention phase, the soda price increase. The mean percentage of healthful chip sales in the grouping phase ( $M = 62.18\%$ ,  $SD = .09$ ) was  $1.78$  percentage points lower than the soda price phase ( $M = 63.96\%$ ,  $SD = .07$ ,  $p = 0.27$ ); however, this difference was not significant suggesting that the healthfulness of chip sales at the end of the study was similar to that at the beginning of the study.

The final phase which removed the color labels saw the mean percentage of healthy chip sales increase significantly by  $6.15$  percentage points to  $65.37\%$  ( $SD = .08$ ) from the washout

phase that preceded it ( $M= 59.22\%$ ,  $SD= .10$ ,  $p= 0.03$ ), although it did not differ significantly from the phase 3 baseline ( $p= 0.13$ ).

There were no significant changes in the percentage of healthy chip sales during the other phases, which include the colored-nutrition labeling, the first health message (the amount of walking one must do to burn off the calories in a regular soda), the healthy substitute pairing and the grouping by healthfulness phases.

Table 11 below further elaborates on our significant findings for chips, presenting the results of the regressions, which we will summarize here as they offer similar information to the above findings. In comparing the water price phase with the phase before it (colored-nutrition labeling), the water price phase was associated with a 3.2% (95% CI= 6.40, 0.00) decrease (the signs on these terms being negative) in the mean percentage of healthy chip sales. In contrast, the emoticon phase was associated with a 2.8% (95% CI= 6, -.4) increase in the mean percentage of healthy chip sales as compared with the baseline water price phase. Similarly, the second health message phase increased the mean percentage of healthy chip sales by 5.6% (95% CI= 1.6, 9.6) compared to the baseline. The washout after the second health message phase maintained this level (that is, it did not remove the effects of the second health message) as the mean percentage of healthy chip sales appeared 3.7% (95% CI= 7.7, -.3) above that of the baseline. The social norm phase, which we noted above was marginally significant (in t-test results) in decreasing the mean percentage of healthy chip sales compared to the washout phase before, was not significant in the regression ( $F(6, 23)= 1.04$ ,  $p= 0.43$ , social norm phase coefficient  $p= 0.13$ ). Finally, the final phase, which involved removing the color labels from the items in the cafeteria, was associated with a 7.9% (95% CI= 2.1, 13.7) increase in the mean percentage of healthy chip sales as compared with the washout phase just before it.



Table 11: *Regression Tables for Significant Chip Interventions*

VARIABLES	Water Price vs Color	VARIABLES	Emoticon vs Baseline	VARIABLES	HealthMsgII vs Baseline
Water Price	-0.032** (0.016)	Emoticon	0.028* (-0.016)	Health Msg II	0.056*** (0.020)
Chip	-0.000 (0.001)	Chip	-0.001 (-0.001)	Chip	-0.001 (0.001)
Tuesday	0.004 (0.025)	Tuesday	0.044* (-0.024)	Tuesday	0.041 (0.026)
Wednesday	0.026 (0.025)	Wednesday	0.047* (-0.024)	Wednesday	0.041 (0.025)
Thursday	0.009 (0.025)	Thursday	0.02 (-0.025)	Thursday	0.040 (0.026)
Friday	-0.006 (0.025)	Friday	-0.014 (-0.026)	Friday	-0.024 (0.027)
Constant	0.685*** (0.048)	Constant	0.658*** (-0.045)	Constant	0.648*** (0.048)
Observations	83	Observations	84	Observations	64
R-squared	0.076	R-squared	0.169	R-squared	0.233

Standard errors in parentheses

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

Table 11: (Continued)

VARIABLES	Washout after HealthMsgII vs Baseline
Washout after HealthMsgII	0.037* (-0.02)
Chip	-0.001 (-0.001)
Tuesday	0.033 (-0.027)
Wednesday	0.047* (-0.026)
Thursday	0.042 (-0.027)
Friday	-0.004 (-0.027)
Constant	0.647*** (-0.051)
Observations	64
R-squared	0.148

VARIABLES	Social Norm vs Washout Before
Social Norm	-0.032 (-0.021)
Chip	0 (-0.001)
Tuesday	0.003 (-0.03)
Wednesday	0.034 (-0.03)
Thursday	0.014 (-0.03)
Friday	-0.017 (-0.032)
Constant	0.675*** (-0.06)
Observations	30
R-squared	0.213

VARIABLES	Final Phase vs Washout Before
Final Phase	0.079** (0.029)
Chip	0.002 (0.001)
Tuesday	-0.007 (0.042)
Wednesday	0.022 (0.042)
Thursday	0.028 (0.043)
Friday	-0.006 (0.049)
Constant	0.457*** (0.100)
Observations	46
R-squared	0.226

Standard errors in parentheses

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

There were no significant changes in the percentage of healthy chip sales during the other phases, which include the colored-nutrition labeling, the first health message (the amount of walking one must do to burn off the calories in a regular soda), the pairing and the grouping phases.

Another explanation for the changes in chip sales or, particularly, the lack thereof, may be substitutable goods that are available and whose sales may have been affected by our interventions but the results of which have not been captured in the aforementioned analyses. For beverages, the issue of substitutes is endogenous to our analyses as we studied almost all beverages in the cafeteria and there is not a clear substitute for beverages outside of the beverage category. However, for chips, one clear healthful substitute for a snack or side item is fruit, especially given that in the cafeteria the individual pieces of fruit are located on a rack near the chip rack. For this reason, we analyze changes in fruit sales across the intervention phases with our focus initially on the interventions that did not appear to significantly affect the healthfulness of chip sales, as our alternative explanation is that the interventions affected fruit sales. We could assess the fruit by using a healthy fruit-chip ratio, where the sum of fruit, green chips, and yellow chips (healthy items) are compared to total fruit and chip sales. However, we focus on absolute fruit sales instead so as to isolate and focus on fruit sales apart from chip sales. In the analysis that follows, we provide descriptive statistics for fruit sales followed by the fruit sales for the interventions that had non-significant effects for chips and then the interventions that were significant in our earlier chip analysis.

## **Fruit Sales**

The average number of pieces of fruit sold on a given day was 33 pieces ( $SD= 11$ ), with 3 pieces being the lowest number sold in a day and 74 pieces being the highest. When considering

“all fruit,” that is, pieces of fruit and fruit cups, the average number of fruit items sold in a day was 40 items ( $SD= 12$ ), with 7 being the lowest number of items in a day and 84 items being the highest. Given that fruit sales and “all fruit” sales were highly correlated ( $r= .95, p= 0, n= 434$ ), we will only report the analyses for fruit sales, that is, pieces of whole fruit, as “all fruit” sales, which also includes fruit cups, were very similar. Fruit sales correlated highly with beverage sales ( $r= .39, p= 0, n= 434$ ), chip sales ( $r= .34, p= 0, n= 434$ ), and number of unique transactions ( $r= .46, p= 0, n= 434$ ). Similar to the chip and beverage analyses, we do not control for the number of unique transactions in our regression analyses, and given the high correlation, we do not control for beverage or chip sales.

Focusing first on those interventions that did not yield significant changes in the healthfulness of chip sales, we analyzed changes in fruit sales in the colored-nutrition labeling phase, first health message phase, healthy substitute pairing phase, and grouping by healthfulness phase, comparing each to the baseline (phase 3 water price phase) and to the washout phase just prior to the phase under study, where applicable. For the colored-nutrition labeling phase, which preceded the baseline phase and did not have a washout phase before it, we compared it to the phase that directly preceded it, the soda price increase phase.

In terms of fruit sales, the average number of pieces of fruit sold do not differ significantly between the colored-nutrition labeling phase ( $M= 33$  pieces,  $SD= 10$ ) and the soda price increase phase before it ( $M= 37$  pieces,  $SD= 11, t(139)= 1.83, p= 0.07$ ). Similarly, the average number of pieces of fruit sold do not differ significantly between the first health message phase ( $M= 29$  pieces,  $SD= 7$ ) and the washout phase before it ( $M= 30$  pieces,  $SD= 8, t(33)= 0.26, p= 0.80$ ) or the baseline phase 3 ( $M= 25$  pieces,  $SD= 8, t(62)= 1.74, p= 0.09$ ).

In contrast, the average number of pieces of fruit sold in the healthy substitute pairing phase ( $M= 33$  pieces,  $SD= 14$ ) was significantly higher than that of the baseline phase ( $M= 25$  pieces,  $SD= 8$ ,  $t(62)= 2.56$ ,  $p= 0.01$ ), although, it did not differ significantly from the washout phase before it ( $M= 36$  pieces,  $SD= 14$ ,  $t(27)= 0.57$ ,  $p= 0.57$ ).

In addition, for the grouping by healthfulness phase, the average number of pieces of fruit sold ( $M= 36$  pieces,  $SD= 12$ ) was significantly higher than that of the baseline phase ( $M= 25$  pieces,  $SD= 8$ ,  $t(71)= 4.56$ ,  $p< 0.001$ ), although, it did not differ significantly from the washout phase before it ( $M= 32$  pieces,  $SD= 9$ ,  $t(37)= 1.17$ ,  $p= 0.25$ ).

Table 12 below further elaborates on our significant fruit findings for these phases that were not significant for chips. The table presents the results of the regressions, which we will summarize here as they offer similar information as the above analyses. In comparing the healthy substitute pairing phase with the baseline phase, the healthy substitute pairing phase was associated with a 7.4 (95% CI= 2.13, 12.72) increase in mean fruit sales. Similarly, the grouping by healthfulness phase increased mean fruit sales by 10.66% (95 CI= 6.50, 14.82) compared to the baseline.

Table 12: *Regression Tables for Significant Fruit Interventions that were NS with Chips*

<b>VARIABLES</b>	<b>Healthy Substitute Pairing vs Baseline</b>	<b>VARIABLES</b>	<b>Grouping vs Baseline</b>
Healthy Substitute Pairing	7.422*** (2.648)	Grouping by Healthfulness	10.655*** (2.080)
Tuesday	8.308** (3.519)	Tuesday	12.269*** (3.100)
Wednesday	9.538*** (3.519)	Wednesday	12.602*** (3.100)
Thursday	7.787** (3.592)	Thursday	11.882*** (3.155)
Friday	-1.615 (3.519)	Friday	3.002 (3.100)
Constant	20.441*** (2.562)	Constant	17.313*** (2.306)
Observations	64	Observations	73
R-squared	0.304	R-squared	0.465

Standard errors in parentheses

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

Thus, while the fruit sales do not appear to change significantly in the colored-nutrition labeling phase or the first health message, fruit sales do appear to increase in the healthy substitute pairing phase and the grouping by healthfulness phase in comparison to the earlier baseline phase- but not in comparison to their respective prior washout phases. Given that neither the colored-nutrition labeling phase nor the first health message phase saw healthful chip sales increase or fruit sales increase, it is clear that these interventions did not have a positive impact on healthful chip and fruit sales. In contrast, while the healthy substitute phase and the grouping by healthfulness phase did not improve the healthfulness of chip sales, fruit sales did increase during these phases, suggesting the two phases had a partially beneficial impact. (This

may be spurious given that the pairing and grouping interventions were only done with the chips and not with the fruit, but regardless, we note the significant change in fruit sales).

Turning our attention to those interventions that already yielded significant changes in the healthfulness of chip sales but whose affect on fruit sales might provide additional information as to the interventions' effectiveness, we analyzed changes in fruit sales in the baseline water price phase, the emoticon phase, the second health message phase, the social norm phase, and the final phase. We compared each to the baseline (phase 3 water price phase) and to the washout phase just prior to the phase under study, when applicable. For the baseline water price phase, which is itself the baseline phase and which did not have a washout phase before it, we compared it to the phase that directly preceded it, the colored-nutrition labeling phase.

With regards to the baseline water price phase, we found, unexpectedly, that the average number of pieces of fruit sold was significantly lower ( $M= 25$ ,  $SD= 8$ ) as compared with the colored-nutrition labeling phase ( $M= 33$  pieces,  $SD= 10$ ,  $t(71)= 4.56$ ,  $p< 0.001$ ) which preceded it.

For the emoticon phase, although red chip sales dropped during this phase, the average number of pieces of fruit sold did not differ significantly between this phase ( $M= 26$  pieces,  $SD= 10$ ) and the baseline water price phase before it ( $M= 25$  pieces,  $SD= 8$ ,  $t(82)= 0.17$ ,  $p= 0.87$ ). This suggests that people were not substituting fruit for the red chips, as fruit sales remained similar during the emoticon phase to those sales in the phase just prior to the emoticon phase.

In contrast, the average number of pieces of fruit sold in the second health message phase ( $M= 31$  pieces,  $SD= 7$ ) was significantly higher than that of the baseline phase ( $M= 25$  pieces,  $SD= 8$ ,  $t(62)= 2.44$ ,  $p= 0.02$ ), although, it did not differ significantly from the washout phase before it ( $M= 31$ ,  $SD= 7$ ,  $t(28)= 0.17$ ,  $p= 0.87$ ). Similarly, the average number of pieces of fruit

sold in the social norm phase ( $M= 40$  pieces,  $SD= 14$ ) was significantly higher than that of the baseline phase ( $M= 25$  pieces,  $SD= 8$ ,  $t(62)= 5.04$ ,  $p< 0.001$ ), although, it did not differ significantly from the washout phase before it ( $M= 36$  pieces,  $SD= 10$ ,  $t(28)= 0.98$ ,  $p= 0.34$ ). Likewise, for the final phase which removed the colored-nutrition labels, the average number of pieces of fruit sold ( $M= 30$  pieces,  $SD= 12$ ) was significantly higher than that of the baseline phase ( $M= 25$  pieces,  $SD= 8$ ,  $t(71)= 2.19$ ,  $p= 0.03$ ), although, it did not differ significantly from the washout phase before it ( $M= 35$  pieces,  $SD= 9$ ,  $t(44)= 1.45$ ,  $p= 0.15$ ).

Table 13 below elaborates on our significant fruit findings for these phases that were also significant for chips. The table presents the results of the regressions, which we will summarize here as they offer similar information as the above analyses. In comparing the baseline water price phase with the colored-nutrition labeling phase that preceded it, the baseline water price phase was associated with a -7.4 (95% CI= -11.28, -3.79) decrease in mean fruit sales. In contrast, compared to the baseline phase, fruit sales increased during the second health message phase by 5.71 (95% CI= 1.43, 9.98), the social norm phase by 14.66 (95% CI= 9.03, 20.29), and the final phase by 5.19 (95% CI= .56, 9.83), respectively.



Table 13: *Regression Tables for Significant Interventions for Fruit that were also Significant for Chips*

VARIABLES	Color vs. Baseline	VARIABLES	HealthMsgII vs Baseline	VARIABLES	Social Norm vs Baseline	VARIABLES	Final Phase vs Baseline
Baseline	-7.531*** (1.873)	HealthMsgII	5.705*** (2.139)	Social Norm	14.657*** (2.815)	Final Phase	5.194** (2.317)
Tuesday	9.300*** (2.921)	Tuesday	9.154*** (2.843)	Tuesday	5.000 (3.742)	Tuesday	3.000 (3.396)
Wednesday	5.653* (2.921)	Wednesday	8.769*** (2.843)	Wednesday	3.231 (3.742)	Wednesday	2.733 (3.396)
Thursday	6.529** (2.967)	Thursday	7.801*** (2.902)	Thursday	6.987* (3.819)	Thursday	0.323 (3.524)
Friday	-2.111 (2.921)	Friday	2.385 (2.843)	Friday	-3.077 (3.742)	Friday	-5.133 (3.396)
Constant	28.894*** (2.401)	Constant	19.606*** (2.070)	Constant	22.848*** (2.724)	Constant	25.002*** (2.522)
Observations	83	Observations	64	Observations	64	Observations	73
R-squared	0.333	R-squared	0.295	R-squared	0.386	R-squared	0.157

Standard errors in parentheses

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

Thus, while the fruit sales do not appear to significantly change in the emoticon phase, fruit sales do increase in the second health message phase, the social norm phase, and the final phase as compared to the earlier baseline phase, although not in comparison to their respective prior washout phases. In addition, fruit sales in the baseline water price phase are actually significantly lower than the phase immediately preceding it, the colored-nutrition labeling phase. This raises the question of whether fruit sales in the water price phase is the appropriate baseline comparison for the others, as most of the other phases had significantly higher fruit sales than the water price phase with the exception of the first health message phase and the emoticon phase.

To assess the cumulative effects of all the interventions, we compared fruit sales in the grouping by healthfulness phase to those in the first intervention phase, the soda price increase. The mean number of daily fruit sales in the grouping by healthfulness phase ( $M=36$ ,  $SD=12$ ) was actually 1 less than the mean number of daily fruit sales in the soda price phase ( $M=37$ ,  $SD=11$ ) although this difference was not significant ( $t(129)=0.20$ ,  $p=0.84$ ). This suggests that overall fruit sales were the same at the end of the study as they were at the beginning.

### **Robustness Checks**

We conducted additional beverage regressions using all the waters except for Vitamin Water. Thus, Evian, Dasani, Dasani 1 liter and Mineral Water were all included in addition to 20-ounce Dasani and 20-ounce other non-flavored, non-specialty waters. The results appeared the same as those reported above with the exception that the second health message was not significant. We also ran the regressions controlling for month, day of week, and number of beverages (chips), but do not report those results due to multicollinearity with the month variable; hence, the month was taken out of the final regressions.

## Discussion

Given the rates and cost of obesity in the United States, a condition largely thought due to lifestyle and behavioral choices like overeating, we sought to explore new methods of encouraging healthy eating in a workplace cafeteria and determine how these interventions compared to the more predominantly used strategies, price changes and nutritional information. Overall, we found that information, in the form of reinforcing health messages, had the most consistently beneficial effect on the healthfulness of purchases. Environmental changes (healthy substitute pairings and grouping by healthfulness) and affect-based cues also increased healthy choices. Cues about social norms had no effect on the target items but may have affected the purchases of healthier, substitute goods (fruit). Although our study focused on beverage, chip, and fruit sales, we believe studying a subset of foods informs our understanding of ways to nudge people to make healthier dietary choices in general without depriving them of the right to choose.

In evaluating the validity and generalizability of our results, it is necessary to review the methodology we used in this study. Across a 21-month long time period, we sequentially assessed 9 different ways to nudge consumer's food purchases in a hospital cafeteria, focusing on beverage, chip, and fruit sales. Our interventions included examples from the two domains typically used by governments and health authorities, namely, price changes and nutritional information. However, for the price changes, we tested a three-tiered beverage pricing system where the most expensive beverages were considered the least healthful, with bottled regular sugar-sweetened soda 25 cents more than diet soda and bottled water 25 cents less than diet soda. For nutritional information, we provided a simplified green-yellow-red color labeling system. We moved beyond these traditional levers through the use of behavioral decision theory to

incorporate other spheres believed to influence decision making, including affective cues, framed health messages, social influence, joint evaluation of choices, and grouping of choice sets. Specifically, we operationalized these domains and tested them using smiley and frowny faces on food items, health messages that told of the exercise required to burn off an item or the percentage of total daily recommended calories an item represented, social messages that highlighted norms of healthful purchases, pairing a less healthful item with a more healthful one to indicate potential substitutes, and grouping items by healthfulness as defined by the colored-nutrition labeling system. For ease of data analysis, we focused on a subset of items—beverages, chips, and fruit—and items within these categories that were in the cafeteria throughout the study and the healthfulness of which we could identify based on the pre-existing register receipt data. In what follows, we discuss our results in light of our hypotheses and previous research.

### **Price Changes**

We had hypothesized that the increase in price of regular soda would decrease regular soda sales and the decrease in price of water would increase water sales. While we were unable to assess the effects of the soda price increase due to the data, we were able to determine that total beverage sales did not change as compared with a year prior. Given that Block reported a 35% price increase reduced sales of regular soft drinks by 26%, assessing the impact of lower price increases like ours of 16.6% which may be more politically feasible seems important for future research.

With regards to the price decrease on water, we did not find any change in the healthfulness of beverages purchases. The only study similar to ours that tested a price decrease in a hospital cafeteria—a 10% (13-cent) price decrease on all zero-calorie beverages, meaning water but also diet sodas—found that the price decrease did significantly increase sales of zero-

calorie beverages in two out of the three experimental sites studied (Jue et al., 2012, p. 630). It is possible that only regular water drinkers, who were already buying water, noticed the discounted price in our cafeteria and that the findings from Jue et al. (2012) were entirely driven by the decrease in diet soda price. It is also possible that we did not find an effect of the reduced water price because the cafeteria has free tap water available for patrons.

Although we had not anticipated the decrease in water price to affect the healthfulness of chip sales, we noted a significant decrease in the healthfulness of chip purchases compared to the prior (colored-nutrition labeling) phase. There are several possibilities for this. Economic theory related to cross-price elasticities which we discussed earlier would suggest that if the price of water, a healthful good decreases, sales of a less healthful good that could be considered a complement (chips) might increase, as consumers choose to buy the healthful good (water) and also the complementary but unhealthy good because they have money leftover. Prior experimental studies have found that subsidizing healthy items can lead to an increase in unhealthy food purchases (Epstein, Dearing, Roba, & Finkelstein, 2010). To this explanation, psychologists might add that having already acted in a virtuous manner by selecting a healthful good and saving money with that purchase, people either feel licensed to buy the less healthful good or feel depleted from using self control to make the healthful purchase and therefore also choose the less healthful item (Baumeister, 2002; Khan & Dhar, 2006; Kivetz & Simonson, 2002; Muraven, Tice, & Baumeister, 1998; Vohs et al., 2008). Thus, it is possible that either chip sales in general might increase because people have extra money or red chip sales in particular might increase because people are choosing to counteract their virtuous water-buying behavior with the vice of red chip selection. The mean number of chips purchased does not vary in the water price phase compared to the phase before it; only the healthfulness of the chip sales

differs. We also noted that sales of fruit, a potential healthy substitute for chips, decreased during the water price decrease phase as well, further suggesting a decline in healthful purchases during this period. Although we can only speculate given the type and amount of data we have as to why the percentage of healthy chip sales declined and the quantity of fruit sales fell in the same time period when the price of water was reduced, this may be one argument for taking care in instituting what appear to be policies subsidizing a healthy good (i.e., water) as the result could be an unexpected change in the healthfulness (chips) or absolute quantity (fruit) of another category of goods.<sup>53</sup>

### **Colored-Nutrition Labeling**

With regards to cognitive interventions, our third hypothesis asserted that colored-nutrition labeling would increase sales in the most healthful categories (“green” and “yellow”) compared to the least healthful (“red”). We found clear evidence in support of our hypothesis for the beverages, despite this being the second intervention, following the soda price change, which prior research suggests may have already significantly increased the percentage of healthful beverage purchases. This finding is in line with other research involving colored labels and beverages in hospital cafeterias (Levy et al., 2012; Thorndike et al., 2012).

However, we were surprised that the color-labeling intervention did not affect the healthfulness of chip sales or the quantity of fruit purchases. It is worth noting that this intervention, which has been widely touted as being one of the more effective nutrition labeling

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<sup>53</sup> In addition, we noted earlier that during phase 3, there were two cafeteria changes that we controlled for—system-wide changes in several cafeteria items and the addition of larger, more resilient color labels. While neither of these changes appeared to have any significant impact on the healthfulness of beverage or chip sales such that we rolled that data into phase 3 rather than removing it from that phase, it is worth noting that some of these price changes or new labels might have affected behavior. However, we do not have any statistical evidence of this, despite treating these two additional cafeteria changes as separate phases in our analyses of beverages, chips, and fruit.

techniques (Borgmeier & Westenhoefer, 2009), was effective for beverages but not for other food categories, namely chips and fruit. This suggests that it would be worth assessing the effectiveness of colored-nutrition labeling across all foods to determine if it is successful in only certain categories or largely in all (and our results perhaps anomalous).

## **Health Messages**

Our next cognitive interventions involved offering two sequential health messages, with the message type (percentage of daily calories and exercise) counterbalanced across our two targeted items (beverages and chips) in the consecutive phases. We found that the first health message pair (percentage of daily calories for beverages, exercise for chips) was not effective in significantly changing the percentage of healthful beverage or chip sales or the quantity of fruit sold but the second health message (exercise for beverages, calories for chips) did indeed increase the percentage of both healthful beverage and chip sales and the quantity of fruit sold in the cafeteria. Consequently, we did not find support for our hypothesis that the exercise message would, for both products, be more effective than the percentage of daily calories message; it appears that our hypothesis held only for beverages but not for chips. In addition, despite the significance of the second health message, we did not find evidence for a cumulative effect of the health messages, as the effect of the second health message was not significantly higher than the washout prior to the first health message.

There are several interpretations of these results. Given that it was the second health message that affected sales and that this second health message was different for the two product categories, it is possible that providing one health message and then offering another health message—regardless of the actual content of the health message—impacted consumer behavior. It may be the number of unique messages that is useful, such that the first message has little

impact but seeing a different one several weeks later (for the same product) allows one to recall the first message while seeing the second message and the two impact sales together. We think this repetition of health messages theory is most probable and the cumulative effect of the health messages might become more evident and significant beyond just two phases.

Alternatively, the amount of time a health message is in place could be important, given that the first message was in place for only three weeks, followed by a three week washout and then the second message for three weeks. Had the first health message been in place for a longer duration, it is possible that it might have influenced sales. This is somewhat puzzling as past research shows that the impact of food interventions—calorie labeling, for instance—is more likely to occur immediately and remain constant over time than to have a lagged effect showing up later in time (Bollinger et al., 2010; Chu et al., 2009). However, it may depend on the type and magnitude of the intervention, as a simple health message on a sign like ours is much less invasive and pervasive than the sudden influx of calorie labels on products. Other studies have questioned whether these interventions would increase or decrease over time (Elbel et al., 2009).

### **Healthy Substitute Pairing and Grouping by Healthfulness**

In terms of our environmental interventions, neither the healthy substitute pairing nor the grouping by healthfulness intervention significantly affected the healthfulness of chip sales, although fruit sales increased in both compared to the earlier baseline. However, for beverages, the pairing intervention decreased the percentage of healthful sales compared to both the phase 3 baseline and the prior washout phase, contrary to our hypothesis. In direct contrast, the grouping intervention significantly increased healthful beverage sales as we hypothesized, and given that the pairing phase actually decreased sales, the grouping intervention clearly increased percentage of healthful sales to a greater extent than the pairing phase, contrary to our prediction.



It is not immediately clear why neither intervention affected chips. Although the healthfulness of the chips sold did not appear to differ in the pairing and grouping phases, the volume of sales was significantly higher during the pairing phase as compared to the grouping phase and volume may have been affected by our interventions. Thus, although the healthfulness of chip sales was not affected, it is arguably beneficial for consumer health for chip sales to decrease overall as they did in the grouping phase. This is again support for the grouping phase in encouraging healthful choices as compared to the pairing phase.

As for beverages, the decrease in healthful purchases during the pairing phase may be an adverse reaction to what may appear to be too paternalistic or heavy-handed. Another possibility is that customers may be reacting to the fact that this signage offers the diet drink as the healthier alternative. Recall that earlier in the study, some customers complained that diet drinks were labeled green, feeling that this was not appropriate possibly due to the chemicals like aspartame or caramel coloring or research that suggests that diet drinks actually lead to weight gain (Blum, Jacobsen, & Donnelly, 2005; Colditz et al., 1990; Jacobson, 2011; Soffritti et al., 2010; Stellman & Garfinkel, 1986; Yang, 2010). Research has shown that people have a tendency to respond defensively to information that conflicts with their current beliefs and understanding (Kunda, 1990). Moreover, if that information both feels threatening and personally relevant, in this case, a regular soda drinker or a coke drinker since regular coke was used in the pairing signage, consumers can be even more motivated to respond in a defensive manner (Good & Abraham, 2007; Kessels, Ruiter, & Jansma, 2010; Liberman & Chaiken, 1992). Thus, rather than decreasing regular beverage sales and increasing diet beverage sales, the message may have incited defensive behavior in loyal coke drinkers and led to even increased sales.

Yet another explanation for these results relates to research we mentioned earlier alongside our hypothesis. Our hypothesis was based on research that indicates that a joint evaluation of two items prompts a reasoned, rational analysis of the two (Bazerman et al., 1999). Another set of literature suggests that such a pairing enables attributes of the items that might be difficult to evaluate on their own to be evaluated more easily when the two are seen together and a basis of comparison provided (Hsee, 1996; Hsee et al., 1999). We had suggested that two dimensions for foods might be healthfulness and taste, though there are others like price, which could be considered. We thought that healthfulness would be an easier to evaluate characteristic given the colored-nutrition labels which were in place and that taste, which cannot be experienced merely by looking at an item in the cafeteria, would be a more difficult-to-evaluate feature of products in the cafeteria. In light of the second set of literature and the evaluability hypothesis, it is possible that the difficult-to-evaluate feature of taste would receive more attention than it otherwise would (and healthfulness less) in a paired evaluation than when the choice was not made as explicit and customers engaged in more of a separate evaluation. In this scenario, considering just healthfulness and taste, it is possible that the pairing caused people to judge on taste and choose the regular Coca-Cola over the Diet Coke. However, whether taste or healthfulness or even price (with regular Coca-Cola being 16% higher in price) is easy or difficult to evaluate—or even the main attributes customers considered in this cafeteria—is an empirical question. We merely want to highlight that other theories about joint and separate evaluation suggest that aside from a potentially more reasoned, rational choice, joint evaluation may serve to enable the evaluation and comparison of attributes that might have received less attention and less weight in the decision process when products were considered individually.<sup>54</sup>

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<sup>54</sup> In theory, products in a cafeteria that are already near each other are probably not considered or evaluated

We can only speculate on an explanation, but the strong reaction to the beverage version of this intervention—which we note was just a single 8.5 x 11 inch sign—stands as a caution to the possible unanticipated behavioral responses to well-intended environmental changes.

In contrast to the response from the healthy substitute pairing phase, the grouping by healthfulness phase brought the beverage level up significantly after the washout following the pairing phase. Grouping may have been a more effective intervention (in a positive manner) than pairing because consumers are used to experiencing products grouped by type (beverages, chips) already, so re-arranging within a healthful color category to create further divisions may not feel as paternalistic or appear to infringe as much on an individual's choice.<sup>55</sup> In research with focus groups, Lando and Labiner-Wolfe (2007) noted that consumers favored placing healthful food combinations in a separate section of menu boards; physically separating the foods by healthfulness may be similarly appreciated, although we do not know as we did not conduct a survey of cafeteria patrons or a focus group.

Earlier we noted that arranging foods by health category could be most helpful for consumers who have already decided to eat healthfully, such that having foods grouped by healthfulness enables them to focus on green or yellow items and essentially ignore red items. We noted that for those pre-committed to making healthful choices, sub-setting items in this way simplifies their decision by shrinking the choice set and potentially increasing satisfaction with their choice as they have a lower likelihood of regretting not choosing a less healthful item since those items were effectively removed from their choice set. In comparison, we expected those who had not decided in advance to eat healthfully to be more helped by the pairing condition,

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individually in the sense that the theories originally had expressed; nevertheless, drawing a customer's attention to the explicit choice of the two items is likely a different psychological phenomena than having the products near each other, requiring the consumer to move a step further and choose to recognize the choice between the two himself.

where they would be reminded of a healthier option that could be substituted for the less healthful option. Given that at any given period in the course of the study the percentage of healthy beverages sold was roughly 75%, it is possible that the cafeteria patrons in the Rainbow Café fall into the first category of people, who have chosen to eat—or at least drink—healthfully such that they responded better to the grouping than to the pairing.

### **Social Norm Message**

For our social norm intervention, we had hypothesized that displaying a message related to the behavior of others in the cafeteria that indicated a social norm of purchasing healthful items would increase the percentage of healthful beverages and chips sold. Further, we had anticipated that, following Burger and Shelton (2011) where a social norm message increased stair use by 46% while an exercise message had no impact, our social norm intervention would be even more effective than our health message interventions. We did not find support for either of these hypotheses, as the social norm intervention did not significantly increase (or change) the percentage of healthful sales for either beverages or chips, although it appeared to marginally increase the sales of red chips ( $p = 0.066$ ) and increase fruits sales as compared to the baseline phase. In this section, we will discuss differences between Burger and Shelton's (2011) work and our own which might explain our results and also consider the differences between our beverage and chip results, the latter of which were marginally significant.

First, with reference to Burger and Shelton's (2011) research, the health behavior they targeted related to physical activity (walking the stairs or taking the elevator) while our health behavior targeted dietary choice and purchasing behavior. It is possible that different behaviors are more or less influenced by normative behavior, and while past research has indicated the influence of the presence and behavior of people on the dietary choices of other individuals,

there may be mediators or moderators that we have not defined and have yet to be explored (Burger et al., 2010; McFerran et al., 2010).

In addition, the normative behavior that Burger and Shelton (2011) targeted was more common and higher—“more than 90 percent”—compared to either of ours, “over 3/4” and “over 2/3,” and perhaps more compelling for this reason. There may be a certain threshold above which normative behavior must already be in order to change the behavior of the rest of the group. If this is true, it may vary based on the behavior of interest, as “over 90 percent” increased stair use (Burger & Shelton, 2011) while “75%” was sufficiently high enough to increase the reuse of hotel towels (Goldstein et al., 2008). (75% may be sufficient to increase stair use as well; we cannot determine this because the stair study only used 90 percent.)

With respect to our own study and our two social norm messages, in an effort to be accurate about the true normative behavior of patrons, we used different fractions for the beverage and chip messages, “3/4” and “2/3,” respectively. We truthfully could have used the phrasing “over 2/3” in both statements, however that would have vastly underrepresented the true percentage of healthful beverage sales and consequently, we chose “over 3/4” for the beverage message. While the “3/4” message for beverages did not seem to have an impact, the “2/3” message for chips, while not significant, appeared to encourage unhealthy chip purchases rather than the healthful sales, which was not our intention. Given that the main distinction between our two messages was the fraction (both the actual numbers used and the amount the fraction equaled), it is possible that the lower ratio used for the chips was not sufficiently high enough to encourage healthful purchases, and may in fact, have served to encourage unhealthy purchases. This might be true if people had expected that a higher percentage of the cafeteria patrons purchased healthful chips or felt that red chip purchases making up one third of the chip

sales sounded like a lot of people—rather than few people. If we did unintentionally encourage unhealthy chip purchases, we would count ourselves in the company of the IRS and the National Park Services both of whom have inadvertently used social norms to encourage the exact thing they meant to prevent (Cialdini et al., 2006; Griskevicius, Cialdini, & Goldstein, 2008; Kahan, 1997).

It is also possible, as was our explanation in the pairing phase for beverages, that people reacted negatively to what they may have perceived to be messages trying to control or influence their behavior, thus choosing to act against the messages' intended effects. We can only speculate on the reasons the percentage of healthful chip sales decreased during this phase; again, this stands as a cautionary tale of the unintended impact of such interventions.

## **Emoticons**

Our final hypothesis related to an affective intervention, whereby we anticipated that placing smiley faces on green items would increase sales of healthful items while frowny faces on red items would decrease sales of unhealthy items, ultimately leading to an increase of percentage of healthful items for both beverages and chips. However, this phase had no impact on the healthfulness of beverage sales but did significantly increase the percentage of healthful chip sales as compared to the phase 3 baseline.<sup>56</sup> Moreover, the change in chip sales in the

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<sup>56</sup> Although this phase had no impact on the healthfulness of beverage sales, we do note that total beverage sales in this phase ( $M= 362$  beverages daily) significantly differed from the phase before ( $M= 394$  beverages daily,  $t(82)= 2.24, p= 0.03$ ) and after ( $M= 410$  beverages daily,  $t(53)= 2.86, p= .006$ ), with beverage sales being lower in this phase. Sales over this time period were only marginally different from the same time period a year before ( $M= 391$  beverages,  $t(69)= 1.85, p= .07$ ).

In addition, we note that this phase occurred in the time period from December 12, 2011-February 3, 2012 and may have been affected by the season—part of which involves the holiday season including Christmas, Hanukkah, and New Years—and any behavior associated with the holiday including greater absence from work (due to travel or personal days) which appear to yield lower purchases overall. The average number of daily transactions in this phase ( $M= 1,109$  daily transactions) did not differ significantly from the average number of daily transactions in the

emoticon phase as compared to the baseline phase before appears to be entirely driven by a decline in red chip sales rather than any change in green and yellow chip sales. Thus, the emoticon phase saw total chip sales decrease as we discussed above with beverages, but percentage of healthful chip sales increased as green and yellow sales remained constant while red sales dropped. Consequently, the intervention appears to have been more effective in discouraging red chip sales rather than actually promoting green chip sales. (Fruit sales remained unaffected.) People may have simply chosen not to buy red chips and not to buy any chips at all. This implies that a red frowny face may be more impactful than a green smiley face. Given that people are loss averse, feeling the pain of a loss of a given amount more than the joy of a gain of the same amount, consumers may have felt the negative affect of the red frowny face more than the positive affect of the green smiley face (Camerer, 2005; Kahneman & Tversky, 1984; Tversky & Kahneman, 1991). Alternatively, there may be a social prime inherent in the face such that consumers may feel that someone is actually frowning on their food choice, as people tend to behave better in a variety of ways when they feel they are being watched (Burnham & Hare, 2007; Ernest-Jones, Nettle, & Bateson, 2011; van der Linden, 2011).

It is worth considering why the emoticon intervention had the intended impact for chips and no significant impact for beverages. If it is true that the red frowny face is more impactful than the green smiley face, then chips, which might be considered a “vice” category of food, or at least not a category known for its health benefits, might be more susceptible to this negative affect priming. In addition, given that this intervention took place during the holiday and New Year season where there tends to be simultaneously more holiday foods and parties as well as

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water phase directly before ( $M= 1,141$  daily transactions,  $t(82)= 0.82$ ,  $p= .41$ ) or the year prior ( $M= 1,131$  daily transactions,  $t(69)= 0.53$ ,  $p= .60$ ). However, the average number of daily transactions in this phase was significantly lower than that of the washout phase directly following it ( $M= 1,238$  daily transactions,  $t(53)= 3.09$ ,  $p= .003$ ).

discussion of over-indulgence and restraint, people may be more sensitive to food interventions than beverage interventions during this period, especially as people may ignore beverage calories ("Remember alcohol calories, New Year dieters told," 2013; "Rethink your drink," 2011). This does raise questions for future research regarding the impact of affective cues on different products and product categories.

### **Strengths of the Current Research**

While we concentrated our interventions and analyses on changes in beverage, chip, and fruit purchases, our overarching purpose is to find ways to help consumers make better dietary choices across the whole assortment of food offerings in outside-the-home settings like workplace cafeterias. We are also interested in identifying ways that food vendors and outlets can promote healthy choices amongst their patrons, as in the long-run, we all share in the healthcare costs and disease burdens that can arise from poor dietary habits. From the larger perspective, our research fits into the social psychology and behavioral economics literature dealing with decision making and cognitive biases, as we are testing behavioral decision theory in a real-world context. More narrowly, our work helps to advance research on food choice and adds to the growing body of research on interventions to improve people's dietary decisions and specifically the research in cafeterias and hospital cafeterias on encouraging healthful food selection.

This research has several strengths. As a field study, we sought to test psychological theories outside the lab and implement them in the real world. The cafeteria patrons, our experiment participants, were employees in a workplace setting, making food choices in the midst of their workday, providing external validity to our findings. In addition, our study design was a 21-month longitudinal study with nine research interventions which allowed us to test the



relative effects of economic, cognitive, affective, social, and environmental nudges on food choice, several of which have never been tested to our knowledge in a real-world setting. We know of no other study using a three-tiered beverage pricing scheme, social norm messages with food, joint evaluation with healthy food substitutes, or affective testing with smiley faces and frowny faces on food. We know of only a couple recent studies translating food calorie messages into alternative forms like exercise and percentage of daily calories.

Moreover, this is the only study of which we are aware that compares this number of unique nudges in the same setting. Using the same site for all the interventions allowed us the advantage of assessing the interventions on a stable population in the same environment rather than trying to determine the impact of a number of interventions that had been tested in different settings and on different populations. The ability to evaluate the effectiveness of the interventions in relation to each other—which is best done in the same exact setting—appears particularly valuable given the variation of results of prior research in this domain which has found mixed findings for calorie labeling and price changes and led to much confusion and debate about appropriate interventions. In addition, many prior studies evaluate the impact of interventions on just one type of food item, often beverages or soft drinks, while we analyzed beverages, chips, and fruit in our desire to more thoroughly understand the direct effects of the interventions and possible substitutionary effects.

## **Limitations**

We share several of the same limitations as previous studies (Bleich et al., 2011; Block et al., 2010; Jue et al., 2012; Levy et al., 2012; Thorndike et al., 2012). We note at the outset the general tradeoff that exists in experimental research between internal and external validity. Internal validity describes the confidence researchers have in associating changes in the main

dependent variable, in our case purchases of beverages, chips, and fruit, with the manipulations of the main independent variable, the different “phases” and interventions we conducted (Epstein et al., 2012). Given that our site was a worksite cafeteria and the research took place over a 21-month time period, there are many additional factors that could affect the impact of the interventions, reducing our internal validity more than had we conducted this research in a controlled, lab setting.

However, field research such as this typically prioritizes external validity over internal validity, the former being related to the confidence we have in generalizing the effects of the independent variable, our interventions, to the greater population (Cook & Campbell, 1979; Epstein et al., 2012; Hotz, Imbens, & Mortimer, 2005). Here we must caution that the results from our study may not be extrapolated to the general public because our population tended to be researchers at a hospital, mostly a very educated population. However, because these interventions are meant to interact with underlying cognitive biases, which are mostly unconscious, the education level of the patrons may not impact the generalization of the results too much. It is worth conducting similar research with a broader cross-section of the population; however, we assume that educated researchers in a health-aware environment (a hospital) most of whom already eat a fairly healthy diet (roughly 75% of the beverage purchases we measured were water or diet soda and only 25% were regular soda) may be the hardest “test” case. These limitations regarding internal and external validity are intrinsic to experiment research; the following limitations are more specific to our research.

**Research site limitations: One site, washouts, and location.** Our intervention was at only 1 site. This may be problematic for two important reasons. First, even though there were other cafeterias nearby and the main cafeteria in a nearby building, no other cafeteria seemed

comparable in size or sales to this cafeteria, and therefore, we did not have a comparison site with which to use as a control. Secondly, given that we conducted a series of interventions, any intervention beyond the first intervention may have been biased by the previous interventions. We attempted to control for this by including washout phases and comparing most interventions to both a static baseline (phase 3) and a washout phase just prior to the intervention itself. However, we are mindful of carryover effects from one intervention to the next.

To that end, our washout phases did not always washout the effects of the intervention before them. For the beverages, only the washout after the second health message appeared to “wash out” the impact of that intervention; none of the other washouts is significantly different from the intervention phase that precedes it. Given this, the effects from the healthy substitute pairing and the grouping by healthfulness phases, which did appear to impact purchasing behavior, were not removed by the washout that directly followed them. For the chips, none of the washouts is significantly different from the intervention phase before it; this is notable for significant interventions like the emoticon phase and the second health message phase, and to a lesser extent the marginally significant social norm phase. Most washout phases were three weeks and may have needed to be longer, as Block et al. (2010) noted that the one washout period they included which was four weeks may have been insufficient. Our study is an improvement over Bleich et al.’s (2011) which did not collect some sales data during the washout periods.

Finally, in relation to the research site being a hospital cafeteria in Cincinnati, Ohio, the author of this paper resided in Massachusetts and although she visited several times throughout the data collection period, there are times when the cafeteria could not be monitored which may have affected our results. Items may have been mislabeled or out of stock at various periods. At

one point, the researcher realized that a beverage case had been replaced because it was not functioning properly, but the colored-nutrition labels that had been on the earlier beverage case had not been put on the new case. (This was over a time period of perhaps two weeks). It is possible that there were other issues that arose that went undetected by cafeteria staff or were not reported to the researchers.

**Data collection limitations: Coding problems, manual registers, Starbucks registers, additional products in the cafeteria.** Specifically with regards to our data, we were unable to analyze the purchases prior to phase 1 due to the fact that the register coding did not allow us to differentiate between the various beverages (regular soda, diet soda, and water) and chips in our study. This historical data would have allowed us a better control for seasonality. In addition, this meant that we could not assess the impact of phase 1, the soda price intervention, which, based on prior research, likely had a big impact on the healthfulness of beverage sales. Similarly, due to register coding, we were not able to differentiate chips purchased in a chip/fruit combo from fruit purchases and therefore, could not analyze that portion of chip purchases. We discussed both of these limitations at length earlier and only mention them briefly here.

Related to the coding, we note that the registers required cafeteria staff to manually enter a button to indicate the item sold rather than scan a barcode. As a result, some products may have been entered incorrectly. There is no reason to think that any mistakes would have biased our results in one direction or the other, though.

Also regarding the registers, as we mentioned earlier, there were beverages in the Starbucks kiosk in the cafeteria that were not labeled and a customer could make a selection from that beverage section and potentially pay for it in the regular cafeteria. It is also possible for a customer to make a selection from the cafeteria and pay for it at the Starbucks register;

thus, we would not have counted that purchase in the data we analyzed. If this did occur, it would have been during high frequency hours in the cafeteria and not likely to affect our results, but we cannot be certain.

Furthermore, there were other beverage and food items in the cafeteria—some of which were labeled, others of which were not—and we did not include these in our analyses, as we were trying to narrow the focus of the items that we analyzed. These other items may have been affected by our interventions in ways not currently known or expressed by the data we did analyze. Moreover, we note that there were several different types of water, all of which were labeled in the colored-nutrition labeling intervention, but only some of which were affected by the water price intervention.

In addition, we note that for items we did not track but which were labeled, like sandwiches and salads, the serving size or condiments like dressings that came standard on the salad or on the side often dictated the colored-nutrition label. For instance, a sandwich might be labeled red in the cafeteria but could be considered green if only half the sandwich were eaten. For salads, while many were labeled yellow or red, if the dressing were omitted, the salad might be green. While handouts in the cafeteria explained the labeling and mentioned portion sizes, this level of explanation—eating half a sandwich—was not provided. (However, by the salad station, a sign indicated that a green option for salads would be to omit the dressing or to ask for oil and vinegar instead. The sign was only at the salad station and not near the pre-prepared salads, so some patrons may not have seen it). Consumers may have become frustrated or otherwise not understood why many of the salads and sandwiches were labeled as red or yellow and may have decided to ignore those labels and possibly all the labels in the cafeteria. To effectively expand the use of colored-nutrition labels, it would be important to ensure people

understand the relationship between color labels and portion sizes and optional additions like condiments and dressings.

**Data analysis limitations: Dependent variable, individuals.** With regards to the data we chose to analyze, we used as our dependent variable purchases, a count of the items that were bought, which seemed to be the variable most directly linked to our interventions. However, another measurement might have been changes in energy purchased (calories) or changes in specific nutrients (e.g., carbohydrates, fat, protein), which other research on dietary interventions have considered (Epstein et al., 2010; Giesen et al., 2011; Nederkoorn, Havermans, Giesen, & Jansen, 2011).

In addition, our data did not allow us to track the purchases of individuals. Thus, we do not know how many unique customers experienced each phase or whether certain phases impacted a given customer more than another. We also do not know if any of the intervention phases led to a customer avoiding the experimental cafeteria and choosing to either dine at the main cafeteria or bring food from home as sales data in terms of total transactions does change throughout the study period. We did not conduct any interviews before or during the interventions so as not to impact the study. However, because of this, we do not know what percentage of cafeteria patrons noticed each intervention or what their reactions (e.g., thoughts, feelings) were to each intervention. Further, we do not know how the interventions affected different demographics of the study population. In addition, our inability to follow customer purchases means that our results could have been impacted if during an intervention individuals who were different than the typical cafeteria patrons visited the cafeteria repeatedly, although this is unlikely as this cafeteria was mostly frequented by researchers working in the same building and not by hospitals staff, patients, or families.

## Future Research

Given the number of psychological domains tested in the current research, we feel many questions have been opened and left for future research. First, we would suggest further study using behavioral decision theory in the dietary domain, including worksite and hospital cafeterias but also fast-food establishments, restaurants, and even grocery stores. While each of these settings is unique, there may be techniques that work equally well across all food venues. Moreover, although this research explored nine different interventions across five psychological domains based on behavioral decision theory, there are other possible strategies for operationalizing these domains as well as other domains to explore. We hope our research encourages further exploration into ways in which behavioral decision theory might help improve dietary choices.

An improvement over the current research and much of the related work would be to track individual consumers so as to more directly understand the impact of different interventions. Surveying people would also be beneficial so as to know whether they noticed the interventions and whether they had any thoughts or feelings about the interventions. However, given that people do not always understand their own behavior and in their attempt to explain their behavior, may respond with why they *think* they behaved in a certain way rather than why they actually behaved in that way (Nisbett & Wilson, 1977), we suggest tracking individuals' purchases.

In addition, ideally in this study, we would have a comparison site, another cafeteria where purchases of the same items (or at least a subset of the same items so as to serve as a proxy for the non-intervention purchasing trend) could be tracked during the same time period as the interventions in the Rainbow Cafeteria. The main cafeteria at CCHMC, the only one larger

than the Rainbow Cafeteria, averages 5,000 transactions a day and \$106,000 in revenue a week, (M-Sun). The main cafeteria does not appear to be a suitable comparison site given that it is several times larger in physical size, product offering, and foot traffic, is open longer hours during the day and more days of the week, and is frequented by the larger hospital population which is more diverse than those visiting the experimental cafeteria in the research building. The cafeteria at CCHMC that is just below the Rainbow Cafeteria in size is Vernon Place, averaging 260 transactions and \$800 in sales, every day M-F. Although both the Rainbow Cafeteria and Vernon Place are open on the same M-F weekly schedule, the Rainbow Cafeteria handles nearly 5 times the transactions and cash flow, with 1,200 transactions and \$3,900 in revenue each day. Consequently, Vernon Place, like the main cafeteria, may not be a suitable comparison site. Thus, we did not conduct any analyses using a comparison site. Future studies should attempt to incorporate comparison sites as several prior studies have (Block et al., 2010; Jue et al., 2012; Thorndike et al., 2012; Webb et al., 2011).

Additionally, for any of these interventions to be scaled up and implemented across numerous settings, it is necessary to understand the changes in revenue resulting from the various interventions both in the short run and in the long run. If these interventions are cheap to implement but end up decreasing revenue, businesses may find them financially infeasible notwithstanding potential improved health that may result from the measures and fail to employ them. We believe that future research can show that interventions like those we have explored in this study can be cost neutral or even revenue generating.

Finally, although research similar to ours has been conducted with the hope that continuous exposure to “healthy” food marketing would influence individuals to make healthier choices outside the hospital cafeteria and incorporate them into their daily behaviors (Liebert et



al., 2012), we are mindful of the potential for just the opposite to occur whereby people eat healthfully in one setting and then compensate for that behavior when away from that setting (Downs et al., 2009). In other words, nudging people to eat healthfully in certain settings, like a specially designed worksite cafeteria or on a more widespread scale if public policy were involved, may inadvertently evoke compensatory dietary habits in other settings, as people overweight or overvalue their earlier “healthy” behavior while simultaneously underweighting or minimizing the consequences of their current dietary decisions in the environments with fewer nudges. If so, then encouraging a person to eat healthfully in a worksite cafeteria, could lead them to compensate—or worse, overcompensate—in the future. Such research was beyond the scope of the current project but important to be undertaken in the future. Most public policies in this domain do not consider these perverse or counterintuitive possibilities—an approach which exemplifies the natural undercurrent of behavioral research.

### **Implications and Contribution**

The fact that we found significant results for many of our interventions suggests that policymakers and health experts would benefit from incorporating such methods from behavioral decision theory into their healthy eating campaigns. This is especially true given that most of these are inexpensive techniques amenable to widespread dissemination. The main goal of this research is to find ways of encouraging healthier eating with the ultimate hope of improving health (Duffey et al., 2010; Lowe et al., 2010; Powell, Zhao, & Wang, 2009). Social psychology and behavioral economics may offer more theory-based approaches to behavior change and experimental tools for testing interventions to determine which methods are the most effective. We hope our research encourages others to seek to exploit innate cognitive biases to help consumers make healthful choices.

The ultimate systemic and organizational impact of research like this may be for hospitals and cafeterias—and the food and beverage industry at large—to offer healthier menu choices, as this research process brought to the attention of the cafeteria management and the patrons the surprisingly limited number of healthful choices and, by comparison, the overwhelmingly large number of “red” items (Berman & Lavizzo-Mourey, 2008; Elbel et al., 2009; Webb et al., 2011). We support increasing the number of healthful options while also being mindful of behavioral research that shows that adding healthier items to the menu can increase sales of less healthful foods (Wilcox, Vallen, Block, & Fitzsimons, 2009).

A study like this would not have been possible without buy-in from multiple levels within Cincinnati Children’s Hospital Medical Center (CCHMC), including the CEO and his staff, as well as a committed planning team that included cafeteria management and staff, nutritionists, and the medical director of the Center for Better health and Nutrition at CCHMC (Liebert et al., 2012). Institutions like hospitals whose missions naturally align with improved health may be the best organizations to partner with for this type of research, given the amount of time and patience required for such a study and the willingness to try unorthodox interventions that may affect the bottom line in the short run but that could improve health.

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## Appendix

Table A: *Experimental Phases, Psychological Domains, Intervention, & Hypotheses*

Phase	Psychological Domains	Intervention	Hyp	Hypotheses
1	Economic	Regular Soda Price Increase (.25)	H1	<i>Increasing the price of less healthful foods, specifically sugary soft drinks, will decrease the sales of those items and increase the sales of more healthful items.</i>
2	Cognitive	Red, Yellow, Green Labels added to food	H3	<i>When provided a health-indicator (or health information) in the simplified form of colored-nutrition labels, purchases in the healthiest (“green”) category and moderately healthy (“yellow”) category will increase compared to the least healthy (“red”) category and will make up a larger proportion of total purchases.</i>
3	Economic	Water Price Decreased (.25)	H2	<i>Decreasing the price of more healthful foods, specifically bottled water, will increase the sales of those items and decrease the sales of less healthful items.</i>
4	Emoticons	Smiley/Frowny Faces added to food items	H13	<i>Placing emoticons on food items will impact the purchasing of food items, such that smiley faces on healthy items will increase sales compared to green items without smiley faces and frowny faces on unhealthy items will decrease sales compared to red items without frowny faces.</i>
5	WASHOUT			
6	Cognitive	Health Message 1- % Daily Calories- Soda, Exercise- Chips	H4	<i>In offering a health message related to caloric information to encourage healthful purchases, a message that conveys the percentage of total recommended daily calories that the item contains will decrease the sales of less healthful items and increase the sales of more healthful items.</i>
			H5	<i>In offering a health message related to caloric information to encourage healthful purchases, a message that conveys the exercise required to burn off the calories of the item will decrease the sales of less healthful items and increase the sales of more healthful items.</i>
			H6	<i>In offering a health message related to caloric information to encourage healthful purchases, a message conveying the exercise required to burn off the calories of the item will be more successful in encouraging healthful purchases than one that conveys the percentage of total recommended daily calories that the item contains.</i>
7	WASHOUT			
8	Cognitive	Health Message 2- Exercise- Soda, % Daily Calories- Chips	H7	<i>In offering two sequential health messages, we expect the second message to significantly increase sales when compared with the time period just prior to the first health message.</i>
9	WASHOUT			

Table A (Continued)

Phase	Psychological Domains	Intervention	Hyp	Hypotheses
10	Social Norms	Indicate Healthful Customer Purchasing Behavior	H11	<i>Providing “social norm” information in the form of data related to cafeteria patrons’ healthful purchases- particularly data suggesting a strong norm of purchasing healthful items- will increase the percentage of healthful items purchased in the cafeteria compared to when there is no such information.</i>
			H12	<i>Providing “social norm” information will be more effective in increasing the percentage of healthful items purchased in the cafeteria than will be providing a health message (H4, H5, H6) about the benefits of the healthful option.</i>
11	WASHOUT			
12	Environmental	Suggesting a Healthier Item to Substitute	H8	<i>When an unhealthy food (or beverage) item is placed next to a healthier substitute and clearly labeled as being alternatives with different healthfulness profiles, customers are more likely to select the healthier food item than if the unhealthy items are physically separate from the healthy alternatives.</i>
13	WASHOUT			
14	Environmental	Arranging Products in Areas based on Healthfulness (by Colored-Nutrition Label)	H9	<i>When foods within a category are grouped according to their healthfulness (healthy, neutral, and unhealthy), and the healthy group is displayed more prominently, the percentage of healthy items purchased will increase as compared to when food is not grouped by healthfulness.</i>
			H10	<i>When comparable, potentially substitutable food (or beverage) items are placed next to each other and clearly labeled as being potential alternatives with different healthfulness labeling, customers will purchase more healthful items than when foods (by category) are arranged according to their color-nutrition label in separate green, yellow, and red sections.</i>
15	WASHOUT			
16	Remove all	Remove Red, Yellow, Green Labels that were added to food, (Price changes continue)		